

# Coral-List Discussion Thread:

## *Reefs at Risk*

A [World Resource Institute](#) book

by

**Dirk Bryant, Laretta Burke, John McManus & Mark Spalding**

The following discussion took place on the [Coral-List listserver](#) during June and July, 1998. The thread is reproduced here because of the many valuable comments and topics that came up in the discussion. The complete archives of coral-list discussions may be found [here](#).

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From sobelj%dccmc@cenmarine.com Thu Jul 23 12:09:58 1998

Date: Tue, 23 Jun 1998 19:50:47 -0400

From: sobelj%dccmc@cenmarine.com

To: coral-list@coral.aoml.noaa.gov

Subject: Reefs At Risk

A report entitled "Reefs at Risk" was released at a National Press Club press conference today by the World Resources Institute, ICLARM, WCMC, and UNEP. In addition to this impressive group of producers, the National Press Club event was introduced by NOAA's Terry Garcia, Asst Sec. for Oceans and Atmosphere, Sylvia Earle wrote the opening section, and the contributing authors and reviewers include a virtual who's who of coral reef researchers and personalities. The attractive report does a good job of identifying the major threats to coral reefs: overexploitation (fishing, etc.), pollution (especially land-based), and coastal development (which contributes to the others).

Nonetheless, I can't help but question some of the report's conclusions, findings, and assumptions. These include:

1. The reefs of the Florida Keys face only moderate threat overall?
2. The reefs of the Windward and Leeward islands face greater threat than those of the Florida Keys?
3. The reefs of Southern Belize face greater threat than those of the Florida Keys?
4. Overexploitation is only a threat to those reefs in countries whose per capita GNP is <\$10,000/year or whose per capita fish consumption is >50 Kilograms/person/year?

#4 seems particularly disturbing to me as it seems to be an unjustified assumption that while noted, is not explained, and may be responsible in part for the erroneous conclusions reached in #1, #2, and #3, and perhaps others. This unjustified assumption lead to overexploitation being ignored as a contributing factor to reef degradation in the United States, Australia, New Zealand, Singapore, Hong Kong, Israel, and the Bahamas. Since I participated in the initial methodology workshop for this report back in August of 1997, I know that the contribution of overexploitation/fishing to reef degradation was flagged and highlighted at that workshop by numerous reviewers.

Since no explanation is given in the report for exempting these countries from consideration of fishing impacts, one might speculate that political considerations were involved. Am I missing something? What do others think?

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"The last word in ignorance is the man who says of an animal or plant: 'What good is it?'. If the land mechanisms as a whole is good, then every part is good, whether we understand it or not. If the biota, in the course of eons, has built something we like, but do not understand, then who but a fool would discard seemingly useless parts? To keep every cog and wheel is the first precaution of intelligent tinkering." Aldo Leopold, Round River, 1953.

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...reply follows...

From pdustan@zeus.cofc.edu Thu Jul 23 12:10:10 1998  
Date: Wed, 24 Jun 1998 08:32:56 -0700  
From: Phillip Dustan [pdustan@zeus.cofc.edu]  
To: sobelj@dcmc@cenmarine.com, coral-list@coral.aoml.noaa.gov  
Subject: Re: Reefs At Risk

Don't worry Jack- the reefs of the Florida Keys as we once knew them will be gone soon so no one will have to worry about the problem unless we get mobilized ASAP and really do something beside monitor and "keep a smiley face on it" for the sake of the economy.

Phil.

(Note: Sobel's message was quoted in the original text of this message. To go back to that message [click here](#).)

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...reply follows...

From pmuller@seas.marine.usf.edu Thu Jul 23 12:10:19 1998  
Date: Wed, 24 Jun 1998 12:45:44 -0400 (EDT)

From: Pam Muller [pmuller@seas.marine.usf.edu]  
To: sobelj%dccmc@cenmarine.com  
Cc: coral-list@coral.aoml.noaa.gov  
Subject: Re: Reefs At Risk

Re: Jack Sobel's specific questions:

Please see page 51 of the "Reefs at Risk" report: "Comments on the Reefs at Risk Indicator"

Items 1 and 2 under Tropical Americas specifically deal with the potential underestimate of the threat classification for the Florida Keys and the overestimate for the reefs off southern Belize.

Threats to Florida Keys reefs are also discussed on page 32 in the section "Twelve Reefs at Risk".

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"Discovery consists of seeing what everybody has seen and thinking what nobody has thought." - Albert Szent-Gyorgyi -

(Note: Sobel's message was quoted in the original text of this message. To go back to that message [click here](#).)

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...reply follows...

From smiller@gate.net Thu Jul 23 12:10:27 1998  
Date: Wed, 24 Jun 1998 14:07:55 -0400  
From: Steven Miller [smiller@gate.net]  
To: Phillip Dustan [pdustan@zeus.cofc.edu]  
Cc: sobelj%dccmc@cenmarine.com, pdustan@zeus.cofc.edu,  
coral-list@coral.aoml.noaa.gov  
Subject: Re: Reefs At Risk

Dear Phil,

I have a problem with the "chicken little" approach that is often used in public forums to generate support, controversy, or conflict. And even if "the sky is falling" I think that it's important not to oversimplify by suggesting simple solutions (or even any solution) to problems as complex as coral reef condition - especially in Florida. I don't think that anyone disagrees about the decline of reefs in Florida

(and throughout the Caribbean), but since you imply that there are more actions to take - what exactly do you think anyone can do to make a difference?

Don't you agree that the two biggest factors related to decreased coral cover and increased algae on reefs in Florida and throughout the Caribbean are white band disease and the *Diadema* dieoff, respectively? If water quality is a problem isn't it more likely related to factors that affect the entire Caribbean basin and Gulf of Mexico (due to river runoff from the Great Rivers of South America and the Mississippi), and not local sewage disposal practices (at least there is no evidence that sewage is causing problems on the reefs in Florida - in canals and enclosed nearshore waters yes, but not offshore)? Further, in Florida we are at the northern geographic limit for active reef growth and the system sees significant natural system variation related to temperature (it can get quite cold in the winter), and perhaps other factors related to the Gulf Stream and upwelling. And there is a lot more to say about complexity; I know that you understand all of this.

One solution, already implemented, is to provide no-take protection to reef areas, and the Florida Keys National Marine Sanctuary has a world-class management program in place (and monitoring program) with many no-take areas. So, again, what exactly do we need to mobilize? And why?

I've posted this to the list-server in reply to your first note because I consider this a public forum and not one that is scientific. And everyone is free to rant without review, but you do leave yourself open for rebuttal. Please don't get the wrong idea, I would like to hear the positive steps you think are needed to turn things around - in our lifetime or the next several, since that probably matches up better with processes related to how reefs grow. I ask this for a practical reason too, since I have program management responsibilities for a fairly large and competitively driven coral research program in Florida. I look forward to talking with you, perhaps by phone or directly by email is best.

Steven Miller, Ph.D.  
Associate Director, Florida Program  
National Undersea Research Center  
University of North Carolina at Wilmington

305-451-0233  
<http://www.uncwil.edu/nurc/>  
<http://www.uncwil.edu/nurc/aquarius/>

(Note: Dunstan's entire message, including Sobel's message, was quoted in the original text of this message. To go back to Dunstan's message [click here](#). To go back to Sobel's message [click here](#).)

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...reply follows...

From [lesk@bio.bu.edu](mailto:lesk@bio.bu.edu) Thu Jul 23 12:10:37 1998  
Date: Wed, 24 Jun 1998 17:29:56 -0400  
From: Les Kaufman [[lesk@bio.bu.edu](mailto:lesk@bio.bu.edu)]  
To: [coral-list@coral.aoml.noaa.gov](mailto:coral-list@coral.aoml.noaa.gov)  
Subject: Re: Reefs At Risk

Dear Steve and Phil and everybody,

Reef decline appears to have been widespread in the tropical west Atlantic over the past two decades. Most prominent is the reduction in prevalence of acroporid corals, and increase, in many places, of macrophytes. Belize was unusual in that when the acroporids began to vanish, there was an endemic agariciid (absent elsewhere in the region) that could serve as a partial functional replacement, and it did.

Since the original high-coral coverage condition is more highly valued than what we are seeing more of today, it would undoubtedly be most productive to:

1. appreciate natural trends toward regeneration, and their scaling
2. judge whether natural regeneration is satisfactory
3. develop interventions that facilitate and accelerate regeneration on the largest spatial and smallest temporal scales possible.

Let us presume that Step 2, the regeneration rate concomitant with the passive approach to reef conservation, is not sufficient to offset rates of degradation in Florida. Note that whether this is or isn't the periphery of reef growth doesn't matter. All that matters is that reefs can grow here and it is worth some effort to see that they do. Then we must move on to Step 3.

Step 3 implies aggressive perturbation (some would call it "restoration") experiments. Looking about, I don't see a great many such experiments in progress. Kudos to Richmond and Mueller and their people. What are we doing to adapt and expand their methodologies? What capabilities do we need at our disposal?

- A. ability to upregulate grazing pressure
- B. ability to downregulate nutrient inputs
- C. ability to force-recruit corals on a large scale

My own guess is that grazing pressure in Florida is pretty high (though perhaps the ability to force-recruit *Diadema* would be helpful on a local basis); and that if nutrients are a major issue, we are already doing what we can to reduce the inputs. That means, shouldn't we be looking harder and more seriously than we are at option "C?" This option offers a wonderful probe of the resiliency of the system....if healthy live corals appear on the reef but do not survive, then something probably must be done with A or B, or there is a food web problem with coral predators, otherwise give up on reefs altogether for now because it's a large-scale environmental health issue that must be addressed first.

Since acroporids and agariciids are the principal corals with response times and growth rates commensurate with human intervention, should they not be the principal focus of efforts toward C?

It would be really helpful if we could reach some consensus on this. No one strategy is sufficient to conserve Florida's reefs, but we should be coming up with a clear and articulate definition of the top-priority conservation science and methodologies needed to do the job...and we aren't, unless I've missed something.

Monitoring IS important, but only in the context of adaptive management. What are our goals? What shall our complete litany of interventions be? What room have we left ourselves for trial and error? Are the intervention experiments well designed and sufficiently powerful to serve our needs?

The alternative is to reduce human impacts as much as possible, and then watch and wait.

These are two very different, complementary strategies.

What combination of these do we, as a community, advocate?

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"I believe we are on an irreversible trend toward more freedom and democracy... but that could change."

-Vice President Dan Quayle, 5/22/89

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...reply follows...

From aszmant@rsmas.miami.edu Thu Jul 23 12:10:57 1998  
Date: Wed, 24 Jun 1998 21:59:40 -0400  
From: Alina Szmant [asmant@rsmas.miami.edu]  
To: Les Kaufman [lesk@bio.bu.edu], coral-list@coral.aoml.noaa.gov  
Subject: Re: Reefs At Risk

Les:

FYI:

- a. We've been working on *A palmata* settlement and culture both in the lab and field. Progress is steady but slow, because there has been no real funding for such work (e.g. bootlegged).
- b. We've also figured out how to culture *Diadema* in the lab and been seeking funds to scale up the culture methodology, with no success to date.

Unfortunately, there is lots of money out there for monitoring and assessment, but not much for developing solutions like those you suggest.

Alina

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(Note: Kaufman's entire message was quoted in Szmant's message. To go back to Kaufman's message [click here](#)

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...reply follows...

From aszmant@rsmas.miami.edu Thu Jul 23 12:11:36 1998  
Date: Wed, 24 Jun 1998 21:52:40 -0400  
From: Alina Szmant [asmant@rsmas.miami.edu]  
To: smiller@gate.net, coral-list@coral.aoml.noaa.gov  
Subject: Re: Reefs At Risk

Dear Phil:

I'm too busy to discourse at length about the Florida situation but what to add my support to Steven's excellent reply to your diatribe. In my opinion and having spent a lot of time in the Keys these last 10 years, most of the coral death I have been able to attribute to a specific cause, has been from severe bleaching [regional or global cause, certainly not local], feasting by *Corallophila* (especially the *Acropora*'s) [possibly a consequence of overfishing or trophic disfunction fo some sort], damselfishes [again possibly a result of overfishing], and overgrowth by *Halimeda* [more on the deeper offshore reefs than in the inshore ones, thus not easily attributable to local sewage nutrients but more likely to loss of *Diadema*]. Overfishing is slowing being addressed in the Keys and I dare say that one can see more large groupers and snappers in Fla than almost anywhere else in the Caribbean. The other causes of coral loss appear to be more regional in cause [especially since same symptoms are being seen in remote Bahamas and Dry Tortugas], and thus not likely resolved by any specific "action" by locals in the Keys. Meanwhile, locally high stressors such as sedimentation & abrasion stress caused by the high frequency of severe storms, are likely slowing coral recruitment success.

Alina Szmant

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(Note: Steve Miller's entire message, including Dunstan's and Sobel's messages, was quoted in the original text of this message. To go back to Miller's message [click here](#). To go back to Dunstan's message [click here](#). To go back to Sobel's message [click here](#).)

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...reply follows...

From Steneck@maine.maine.edu Thu Jul 23 12:11:41 1998  
Date: Wed, 24 Jun 98 22:37:04 -0400  
From: Bob Steneck [Steneck@maine.maine.edu]  
To: Les Kaufman [lesk@bio.bu.edu], coral-list@coral.aoml.noaa.gov  
Subject: Re: Reefs At Risk

Dear Les et al.,

Although the decline of *Acropora* is wide-spread in the tropical west Atlantic, based on my observations it is more abundant in the Florida Keys than in many regions of the Caribbean where I've worked over the past several decades (e.g., Bahamas, Jamaica, St. Croix, St. Kits, Bonaire, Honduras, and Yucatan coast of Mexico). What I observed several weeks ago during the field trip in the Florida Keys with the Atlantic and Gulf Reef Assessment workshop was a fair amount of *Acropora palmata* (although some was diseased), evidence of high rates of fish grazing (abundant bite marks), low macroalgal biomass, and high coralline abundance. Bob Ginsburg reported on his rapid assessment of patch reefs of the Keys and the mound corals at least appear to have low rates of mortality.

I was not shocked to read Jack Sobel's report on Reefs at Risk. Many reefs I've studied, even in rather remote regions of the Caribbean are in poorer condition than those I've seen in the Florida Keys. However, before we all run off to conduct remedial action, it might be a good idea to objectively determine the patterns of reef decline. Are we faced with a decline in all species or are we primarily reacting to the decline of *Acroporids* (due to white band disease)? Are patterns of macroalgae resulting from changes in the reef's trophic structure (i.e., loss of grazers) or due to eutrophication or both?

Because the answer to these questions were unclear to me, I felt it worthwhile to encourage the development of a comensurable Rapid Assessment Protocol (RAP) that can be used throughout the Atlantic and Gulf reefs of the Americas. The recent AGRA RAP workshop developed just such a

protocol and 20 groups have agreed to apply it to their reefs. Plans are being made to reconvene another meeting to consider those assessments and with it perhaps a clearer understanding of the patterns and processes will emerge. I suspect we will find that one size does not fit all. But we should be able to suggest which processes are likely to produce the warning signs you and others know all too well.

Finally, the Belize shift from Acroporids to *Agaricia tenuifolia* is interesting (e.g., Aronson and Precht 1997) but not very many kilometers to the north on the Yucatan barrier reef the abundance of *A. tenuifolia* is no where near as abundant as was the *Acropora* once was (as evident from the standing dead *A. palmata*). So I'm not sure the functional replacement is widespread or at least it has not happened there yet. For me, the bigger take-home message from Aronson and Precht's story for Belize and their subsequent observations is that the natural regenerative capacity of the reef (i.e., the coral recruitment potential) remained high because herbivory remained high presumably keeping macroalgal abundance low. Chuck Birkeland made the same point that algal biomass interferes with coral recruitment in his classic 1977 ICRS paper.

It seems to me, understanding the patterns of coral reef condition sufficiently so that plausible forcing-function processes can be identified should be a priority action item for our coral reef research community. I think we do need to collectively consider which reefs are at risk, but we should also identify which reefs are seriously degraded and which ones are relatively pristine. With such information we should be better able to apply our remedial actions intelligently and surgically.

Bob

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The School of Marine Sciences Web site:  
<http://www.ume.maine.edu/~marine/marine.html>

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(Note: Kaufman's entire message was quoted in the original text of this message. To go back to Kaufman's message [click here](#).

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...reply follows...

From marks@wcmc.org.uk Thu Jul 23 12:11:48 1998  
Date: Thu, 25 Jun 1998 10:03:36 +0100  
From: Mark Spalding [marks@wcmc.org.uk]  
To: coral-list@coral.aoml.noaa.gov  
Subject: Reefs At Risk

Many thanks to Jack Sobel for his generally positive comments about Reefs at Risk (<http://www.wri.org/indictrs/reefrisk.htm>). As Dr Sobel is aware the study was an indicator based assessment. We used global maps reflecting a wide range of factors to act as surrogate measures of threat to reefs (in the absence of direct or comparable measures for the majority of the world's reefs). This approach was an effort to introduce some sort of scientific objectivity into a field otherwise dominated by more subjective opinion-based reporting. One of the great difficulties with using indicators is that there will always be exceptions which the indicators are unable to predict. Dr Sobel has clearly pointed out what may be some of the key exceptions (but subsequent arguments on this list underline the difficulty even here), and certainly the problems with Florida and Belize are considered on page 51 of the publication. One of the advantages of a purely quantitative approach, however, is that we can return to the data and ask why such apparent exceptions were not picked up, and then re-assess the whole approach, if necessary making refinements to the methods.

Below we try and address the four particular points which Dr Sobel raises, but before that (and please don't feel obliged to read all this!) we would make three points:

1. This is a GLOBAL review: as such the resolution at the level of individual countries may be poor, but we (and that includes contributors from around the globe representing many institutions) consider that overall it gives a pretty good picture;
2. The report considers "threat" rather than actual current "degradation" - reefs may be indicated as highly threatened, but by good management or by exceptional circumstances may still be in excellent condition;
3. It is a first attempt. Previous efforts, which have been widely used and have helped considerably in raising awareness about the threats to coral reefs have been based on expert opinion, but unfortunately different experts have different opinions while most of the world's reefs are rarely visited by experts. Improved global datasets and possible changes to the methods may lead to considerable refinement of the maps in future versions.

Jack Sobel's particular points:

Florida:

The Florida reefs score medium threat in two of the four threat factors and score as high threat in none, so received an overall score of moderate risk. In particular -

- a. Within the Coastal Development threat factor, the reefs of the Keys are just beyond the 20 km. distance threshold for high threat from a city of over 1 million (Miami), and smaller settlements, airports and tourist resorts only result in a classification of medium threat.
- b. Within Marine Pollution, shipping related threats resulted in a classification of moderate threat.
- c. Overexploitation - as Dr. Sobel points out, population density-based overfishing was not evaluated for the U.S. This exclusion was made based upon the opinion of 20 coral reef experts who participated in the second workshop on the Reefs at Risk methodology. The consensus was that Malthusian-type overfishing does not occur in wealthy countries, so these countries should be excluded from the model, based upon per capita GDP. As destructive fishing is not a threat in the Keys, the Florida reefs were not found to be at risk from overfishing.
- d. Inland pollution and erosion - the watershed-based model used to predict sediment plumes relies upon slope, land-cover type and precipitation for all areas in the watershed. As southern Florida is so flat, the model does not pick up a threat from sediments in this area. (The watershed model is better suited to pick up threats from deforestation in hillier landscapes.)

In this sense, Florida slipped through the net, but had we changed our indicator criteria to include Florida as an area subject to population-density driven overexploitation, it would have scored as high threat. Also, had we allowed tourism pressure to score as high risk, the Florida Keys surely would have qualified. Of course we could do this, but such an alteration would also bring a number of clearly unthreatened reefs into the same high threat category.

#### Belize:

The reason why the reefs of southern Belize are marked as highly threatened is due to their proximity to considerable terrestrial runoff. Clearly this runoff has yet to impact the southern Belize reefs, and it may be that the particulars of the coastal configuration and currents further protect these reefs, but once again we have to look at a wider picture. In the majority of cases reefs lying this close to such a major terrestrial input would be under considerable threat (and this was agreed by the majority of international contributors to Reefs at Risk).

#### The Lesser Antilles:

Degradation on particular reefs is already considerable in this region, but it is of course threats not degradation we are measuring, and these are even greater: over-exploitation, coastal development, sedimentation are all rife. Certainly there are exceptional sites in this region, not degraded or even threatened, but many are small, while the resolution of the study used a 4 km. grid, so many of these would not even show up.

#### Over-exploitation:

Of course this can occur anywhere, what we are trying to do is pick up the cases where it is virtually inevitable and therefore predictable using surrogate measures. Within our modeling of overexploitation of reef resources, we examined two broad types of threat - destructive fishing, such as blast fishing and fishing with cyanide, and Malthusian, or subsistence type overfishing. Areas estimated to be under threat from destructive fishing are based upon documented occurrences of blast or cyanide fishing, revised by our experts at a Reefs at Risk workshop held in Manila last Fall, attended by 20 coral reef scientists. Also at this workshop, the group encouraged us to estimate the demand-based threat of Malthusian overfishing for poverty areas only, as the consensus was that this type of fishing does not occur in wealthy areas, and that the exclusion could be based on per capita GDP and percent of protein in the diet from fish. We implemented this revision to the methodology by using a maximum of \$10,000 per capita GDP per annum, and a fish consumption threshold of 50 kg. fish per person per year. We should have made the rationale for this exclusion clear in the report.

We are delighted with any feedback the report generates, and also hope that it will continue to provoke discussions among reef scientists, managers and/or politicians.

Comments from Mark Spalding (WCMC) and Lauretta Burke (WRI).

#### Mark Spalding

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...reply follows...

From N.Polunin@newcastle.ac.uk Thu Jul 23 12:11:53 1998  
Date: Thu, 25 Jun 1998 10:19:21 +0000  
From: Nicholas Polunin [N.Polunin@newcastle.ac.uk]  
Reply to: n.polunin@ncl.ac.uk  
To: coral-list@coral.aoml.noaa.gov  
Cc: i.d.williams@ncl.ac.uk  
Subject: Reefs At Risk

Dear Colleagues

In response to messages from Les Kaufman and others, Bob Steneck just wrote:

- > However, before we all run off to conduct remedial action, it might
- > be a good idea to objectively determine the patterns of reef
- > decline. Are we faced with a decline in all species or are we
- > primarily reacting to the decline of Acroporids (due to white band
- > disease)? Are patterns of macroalgae resulting from changes in the
- > reef's trophic structure (i.e., loss of grazers) or due to
- > eutrophication or both?

I shall also remain unhappy with thinly-substantiated reports from environmentalist groups, international environmental agencies and NGOs as to the extent and manner of degradation of Caribbean reefs until I see reliable regional comparisons, and preferably time-series, of condition (not proxy assessments of 'threat' or 'risk'), made and disseminated. As to mechanisms, any geographic patterns discerned need rigorously to be related to the sorts of factors involved.

Bob also wrote:

- > It seems to me, understanding the patterns of coral reef condition
- > sufficiently so that plausible forcing-function processes can be
- > identified should be a priority action item for our coral reef
- > research community. I think we do need to collectively consider
- > which reefs are at risk, but we should also identify which reefs are
- > seriously degraded and which ones are relatively pristine. With such
- > information we should be better able to apply our remedial actions

My group's particular approach has been to get an idea of the scope for recovery of the benthic community (based on photoquadrat point-sampling) when fishing is effectively excluded or fish grazing might otherwise be manipulated by:

1. comparing protected and unprotected areas at 5 Caribbean sites; I will give a provisional view of these data at the ISRS meeting in Perpignan this September:

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### Ecological comparisons of fished and protected areas in the Caribbean

Polunin, N.V.C. & I.D. Williams, Department of Marine Sciences & Coastal Management, University of Newcastle, Newcastle upon Tyne NE1 7RU, UK

Concern over reef degradation in the Caribbean and the contention that much of this is caused directly or indirectly by fishing have prompted us to make comparisons between protected (MPAs) and unprotected areas in Jamaica (Montego Bay), Barbados (Folkestone), Belize (Hol Chan), the Caymans (Grand Cayman) and Cuba (Punta Frances), during the period 1997/98. We have broadly categorised the reef benthos from point counts on underwater photographs in six principal categories (macroalgae, turf algae, 'bare' substratum, crustose coralline algae, hard coral and other sessile invertebrates) and characterised the large-fish assemblages of the reefs involved using underwater visual point counts of individuals >12 cm in length in six families (Serranidae, Lutjanidae, Balistidae, Scaridae, Acanthuridae and Haemulidae). The data presented here are derived from replicated sampling in 5-6 sites selected at random each from MPA and adjacent unprotected deeper water (ca 15 m depth) reef. Some groups of large fishes which are important fishery targets tended to be more abundant in MPAs than on unprotected reef in all except the Caymans, but we found no evidence that the benthos systematically differed. Since diving tourists in a Jamaican survey indicated greater preference for fish (abundance, variety and size, in that order) than characteristics of the benthos when they dive, it appears that the Caribbean MPAs we have examined are distinctive in the ways diving tourists most appreciate. However, the evidence is also that reef degradation, particularly the domination of macroalgae over hard corals, which has been attributed to reduced grazing by fish as a result of intensive fishing in localities such as on the northern coast of Jamaica, does not stand to be readily reversed in the deep-water sites we have investigated. Furthermore, the high abundance of macroalgae in areas which appear at least to be devoid of nutrient and fishing effects (the Belize and Cuban localities studied) suggests either that some factor other than local nutrient inputs and fishing has been involved, or that long-range effects, such as of nutrient additions through large-scale mixing, must have been important, unless macroalgal domination greatly predates modern developments.

Acknowledgements. This study has been funded by the UK Department for International Development, and has been possible by collaboration of many colleagues. In particular we thank: Jill Williams, Maldon Miller, Wayne Hunte, Jorge Angulo, Tim Austin and Miguel Alamilla.

- 
2. comparing benthic community structure among areas with de facto variations in the abundance of grazing fishes.

The results of both approaches will be presented formally at a workshop in Jamaica in July 1999. We are drawing up plans for the workshop now, and welcome suggestions of other input. Possibilities exist for part-funding of some participants, especially from developing countries within the Caribbean region.

Nicholas Polunin

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...reply follows...

From [lesk@bio.bu.edu](mailto:lesk@bio.bu.edu) Thu Jul 23 12:12:06 1998  
Date: Thu, 25 Jun 1998 11:26:44 -0400  
From: Les Kaufman [[lesk@bio.bu.edu](mailto:lesk@bio.bu.edu)]  
To: [coral-list@coral.aoml.noaa.gov](mailto:coral-list@coral.aoml.noaa.gov)  
Subject: Re: Reefs At Risk

I concur fully with my esteemed colleague, Bob Stenneck's comments, with one caveat.

The process of developing realistic protocols for enhancement of coral settlement and growth in situ can be conducted in a manner that greatly enhances our understanding of reef regeneration well beyond what we will learn solely through passive monitoring. My plea is for experiments, not massive restoration. That can come later (if ever) once we know what we are looking at.

Certainly with very limited resources, we default to standing by and watching strategically, as the next best thing to do. Let's just understand that that is what we are about. It is a sort of tolerable but nonetheless highly undesirable paralysis.

Les Kaufman  
Boston University Marine Program  
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phone: 617-353-5560  
fax: 617-353-6340

"I believe we are on an irreversible trend toward more freedom and democracy... but that could change."

-Vice President Dan Quayle, 5/22/89

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...reply follows...

From jlang@uts.cc.utexas.edu Thu Jul 23 12:12:14 1998  
Date: Thu, 25 Jun 1998 12:38:00 -0500 (CDT)  
From: "Judith C. Lang" [jlang@uts.cc.utexas.edu]  
To: coral-list@coral.aoml.noaa.gov  
Subject: Reefs At Risk--Help adopt a "Great River"?

Hello all,

I'd like to follow up on Steve Miller's observation that the "Great Rivers" of the Americas are likely to be contributing to problems of water quality in the western Atlantic. For reasons that include enlightened self-interest, perhaps those of us who care about its reefs should seek out and support with our time and/or money local efforts (in states bordering the Gulf of Mexico, Colombia, Venezuela, etc.) to cleanse these rivers of their excess sediments and pollutants.

Judy Lang  
Texas Memorial Museum  
2400 Trinity  
Austin, TX 78705  
(512) 471-4954, -4542 (V)  
(512) 471-9425 (F)

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...reply follows...

From sjameson@coralseas.com Thu Jul 23 12:12:19 1998  
Date: Thu, 25 Jun 98 20:31:51 -0400  
From: Stephen C Jameson [sjameson@coralseas.com]  
To: Bob Steneck [Steneck@maine.maine.edu], Les Kaufman [lesk@bio.bu.edu],  
Coral-List [coral-list@coral.aoml.noaa.gov]  
Subject: Re: Reefs At Risk

Dear All,

On 6/24/98 Bob Steneck wrote:

- > It seems to me, understanding the patterns of coral reef condition
- > sufficiently so that plausible forcing-function processes can be
- > identified should be a priority action item for our coral reef research
- > community. I think we do need to collectively consider which reefs are
- > at risk, but we should also identify which reefs are seriously degraded
- > and which ones are relatively pristine. With such information we should
- > be better able to apply our remedial actions intelligently and surgically.

The U.S. Environmental Protection Agency will be coming out with a new report on the "Development of Biological Criteria for Coral Reef Ecosystem Assessment" that will address the above and hopefully

provide the stimulus for funding a U.S. Coral Reef Biocriteria Program. The entire 90+ page report will be published in the upcoming summer edition of the Smithsonian's Atoll Research Bulletin and has a comprehensive review of coral reef indicator species and other reef monitoring indices - with recommendations for future work.

Jameson SC, Erdmann MV, Gibson Jr GR, Potts KW (in press) Development of biological criteria for coral reef ecosystem assessment. Atoll Research Bulletin, National Museum of Natural History, Smithsonian Institution, Washington, DC

Best regards,

Dr. Stephen C. Jameson, President  
Coral Seas Inc. - Integrated Coastal Zone Management  
4254 Hungry Run Road, The Plains, VA 20198-1715 USA  
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...reply follows...

From pdustan@zeus.cofc.edu Thu Jul 23 12:12:53 1998  
Date: Fri, 26 Jun 1998 12:57:26 -0700  
From: Phillip Dustan [pdustan@zeus.cofc.edu]  
To: smiller@gate.net  
Cc: sobelj%dccmc@cenmarine.com, coral-list@coral.aoml.noaa.gov  
Subject: Re: Reefs At Risk

At 02:07 PM 6/24/98 -0400, you wrote:

> Dear Phil,  
>  
> I have a problem with the "chicken little" approach that is often used in  
> public forums to generate support, controversy, or conflict. And even if  
> "the sky is falling" I think that it's important not to oversimplify by  
> suggesting simple solutions (or even any solution) to problems as complex as  
> coral reef condition - especially in Florida. I don't think that anyone  
> disagrees about the decline of reefs in Florida (and throughout the Caribbean),  
> but since you imply that there are more actions to take - what exactly do you  
> think anyone can do to make a difference?

Steven,

I think I speak from a slightly better vantage point than Chicken Little. And the "sky" isn't about to fall -- in many places large chunks have landed.

The reefs I have been working on have changed dramatically in my scientific career- one that spans a

very short period when compared to the ecology and geology of reefs. In the northern Florida Keys the corals have dropped like flies- from diseases, boat groundings, sedimentation, and a host of other processes. For example, The fore reef terrace of Carysfort reef has a measured 50 to 65% cover in 1975, now its about 12-13% . Key Largo Dry Rocks has probably done the same, as has Molasses and most of the other reefs in the area. This is not new -- the decline has been going on at least since the 70's or earlier. Denial masks many things.

Over the last few years, being a member of the EPA Coral Reef Monitoring Project has given me the opportunity to place my observations from Key Largo in context. And to my eyes, much, if not most of the outer reefs along the Keys are in the same shape.

I have appended a manuscript I wrote for the World Bank which outlines some large steps that we might want to address, but what can we do in the Keys to "help" the reefs?

Judy Lang offers a good point -- adopt a river. Address the problems of watershed effluent where they originate -- the great rivers.

Address the immediate problems facing the corals while we try to figure out whats causing them: Harold Hudson got named the reef doctor because he works towards the health of individual corals.

What else could we do you ask?

- > "Don't you agree that the two biggest factors related to decreased coral cover
- > and increased algae on reefs in Florida and throughout the Caribbean are white
- > band disease and the *Diadema* dieoff, respectively?"

I suppose we could hold a few more workshops, or start another monitoring effort.

Or more seriously we could try to address the problem at the scales it presents:

1. Corals are being killed by algal overgrowth and algal-sediment encroachment at rates that far exceed their growth and/or recruitment rates. Why not get experienced people together (interested naturalists) to tend the reefs like we tend gardens to reduce these stresses. People could play the role of herbivores. This would reduce the algal standing stock (huge at present) and perhaps give the corals some relief.
2. We could do the same at a finer scale around colonial edges. Next time you go diving look closely at the edges of the corals. They are fast being "overgrown" by mats/carpets of filamentous algae and fine sediments. This is not a new problem, but one that seems to be increasing, especially in the keys. Careful hads could clean the edges.
3. While we are administering "first aid" it might be prudent to begin to grow large quantities of diadema and other herbivores in culture. This is not a simple issue, but if we can grow salmon, clownfish, abalone, and other interesting collectibles and delectables, why not important herbivores. And while we're at it, why not stop taking other important herbivores.
4. We could address the problems of watershed effluent- the bleeding of sediments, nutrients, and carbon into the sea. In the keys sewage and nutrients top the list -- so why not deal with it straight out -- spend the money for sewage treatment. There are lots of interesting "biological systems" as well as the standard systems that could be brought to bear on the problem.

But still the land will bleed. People have got to begin to realize that the terrestrial ecosystems are conservative, When we develop them, they leak, like a cut open person. They spill their "guts" into the sea. In the Keys this includes fine sediments, nutrients, carbon, and lots of pollutants. People should try to move the system back to its conservative natural state. Stop using pea gravel and other practices that generate fine sediments, etc. Sure, a lot of the water quality issues come from other places as the Keys are downstream of the whole Caribbean and Gulf of Mexico, but to use this as an excuse for how you treat your home is shameful.

5. I'm sure there are lots of other "action" things we could do to help with the immediate while we attack the larger issues.

I don't think it takes a rocket scientist to figure a lot of this out. Just some practical politics and some consciousness. We presently worry about the reefs and are actively spending money on "restoring" the structure of reefs rather than the system. The reefs are the indicators of larger issues and perhaps, we need to become active at larger scales. And we need to do it fast if we are going to leave more than algal carpeted used-to-be-coral reef for the next generation. When the rains finally do come to Florida, the ash and debris from the fires will create an even greater challenge for the reefs. I, for one, am not convinced that we have to keep a smiley face on the situation to get people to want to help the reefs. I think that a lot of people would rather do something more than watch. Don't you?

One last comment however. Unless the increase in the Earth's human population is somehow brought into reasonable limitation, all we do will probably be wasted in the long run.

Phil

Text of a manuscript in press with the World Bank on the Conservation of Coral Reefs

Coral Reefs, harbingers of global change?

Phillip Dustan

Department of Biology

University of Charleston

Charleston, SC 29424

on behalf of

The Cousteau Society

"Evolution produces a very few new species every million years. If we are to assume that nature can cope with our feverish developments, it is probable that mankind would be submitted to the fate of the dinosaurs. Destruction is quick and easy. Construction is slow and difficult."

J.Y. Cousteau, 1973.

Coral Reefs

Coral reefs form in the tropical, equatorial waters of the world's oceans and are the marine analogs of tropical rain forests. They are the oldest, most diverse and productive ecosystems in the sea. Coral reefs are a reservoir for much of the ocean's biodiversity, provide an estimated 10% of the world's fisheries, and their productivity fuels intense biogeochemical activity linking them to the global carbon cycle. Complex reef structures house some of Nature's most amazing creatures while protecting miles of coastline from the full fury of the sea.

Coral reefs develop to their greatest expression in clear tropical waters under extremely nutrient-poor conditions. Abundant solar energy fuels photosynthetic activity which is transferred to the food web by a host of grazing herbivores (animals that eat plants). This lush development of reefs under extreme oligotrophic conditions created the "paradox of reef" until the role of symbiosis was fully recognized. Now we know that the high productivity of reefs results from the evolution of many symbiotic associations, mainly coral-algal (zooxanthellae), that increase the retention of limiting nutrients, primarily nitrogen and phosphorus. Reef corals are functionally both animals and plants. Ironically, the same intricate patterns of survival that have developed over an immense span of evolutionary time make the reef vulnerable to changes in environmental conditions, especially temperature, sediment, and nutrient concentrations.

Anthropogenic stresses are thought to be contributing to the decline in coral reef ecosystems, notably in the Caribbean and the western Atlantic. Driven by the engine of ever increasing human population, more and more land has been converted from its natural state. Generally, terrestrial ecosystems tend to be conservative and export little in the way of nutrients, carbon, and sediments. But, agriculture, urbanization, and deforestation reduce the capacity of terrestrial ecosystems to trap and retain materials. Development has altered the ecological characteristic of watersheds overloading rivers with sediments, nutrients, and adding toxic chemicals. Simple runoff has become an effluent that can have a significant deleterious influence on water quality. The addition of fertilizers, organic carbon, and urban and commercial dumping further enrich the watershed's effluent as it flows into the sea. When these ecological variables pass some threshold, the species composition of the reef community becomes reorganized.

The addition of sediments and/or nutrients triggers a set of ecological processes that alter the selective pressures facing corals. In disturbed areas, increased loading of sediments and nutrients often co-occur, making it difficult to isolate their individual effects. Generally, increased sediment and nutrient loading favor the growth of macroalgae over corals. Suspended sediments reduce light levels to the corals and coat their soft tissue surfaces. Algae strip nutrients from the water column quickly enabling them to grow faster than stony corals.

Excess sediment, coarse or fine, smothers coral tissue, impeding diffusive gas exchange through the tissues while also reducing the amount of light available for photosynthesis. Since corals work best when their surfaces are sediment-free, their metabolic efficiency diminishes. Energy spent on housekeeping is not available for prey capture, growth or reproduction. As the sediment load increases, the tissues cannot maintain their status and tissue death occurs. Microbes quickly claim the freshly exposed skeleton which is followed by a successional process ending with an algal turf or macroalgal community. Tissue losses increase when, through fishing and collecting, levels of herbivory are reduced or at least altered. Such reefs change from coral gardens to algal-covered rocks, precisely the type of trend which is one of the key problems facing coral reef ecosystems in the Caribbean and western Atlantic today.

Curiously, luxuriant reefs can be found naturally in areas with high sediment loading such as could be found near the mouths of tropical rivers along the Jamaica north coast. The difference is that these reefs developed under these conditions rather than being subject to dramatic environmental shifts after becoming established. Reef corals that have developed under one set of conditions may not possess the necessary flexibility in their physiology or genetic makeup to "cope" with the added stress of rapid environmental change.

The death rate of coral tissue from sediment necrosis increases when algae grow in close proximity to corals. Macroalgae can shade coral tissue causing bleaching and eventually tissue necrosis. Large algal

colonies can also abrade the soft coral tissue as they wave in the surge. Microalgal filaments at the edge of corals, form effective sediment dams which prevent corals from clearing sediment off their surface, slowly suffocating the live tissue. This process, termed edge damage, is a "functional disease" and appears to be a significant source of coral tissue mortality. Additionally, any lesion increases susceptibility to opportunistic pathogens which can kill a colony in less than 1/100 of the time it takes to grow. In the Florida Keys in 1974, I observed the process on reefs that had increased amounts of fine sedimentation. The condition became much more prevalent after the mass mortality of *Diadema antillarum* greatly reduced levels of herbivory. Today, throughout the Florida Keys and Bahamas, almost anything that lives on hard substrate is being overgrown by algae. It is abundant, almost metastatic, on the outer reefs of Key Largo. Molasses Reef, the most heavily visited reef in the world, has thick rug-like algal mats while Carysfort Reef has mats with finer filaments. Both types of algal communities trap sediments and the finer particulate organic snow which shade, smother, and rather quickly kill coral tissue.

The reefs in many parts of the Caribbean and western Atlantic are showing signs of decreasing vitality; coral cover is decreasing while algae are increasing. Coral regeneration is slowing and the increased levels of algal biomass may be, in part, responsible for reduced levels of coral larvae settlement. Signs of stress appear most evident on coastal reefs near population centers. In the Florida Keys, one of the most dramatic sites, I am frequently asked which single factor is responsible, sediments or nutrients? My perspective is that the "factor" may actually be the accumulation of a series of nested stresses which are as local as the fisherman, as regional as the landowner, sugarcane field, or village, and as global as deforestation in Amazonia, the ozone hole, and greenhouse effect. Each factor compounds the rest, a synergy towards death for the reef.

Locating the source of increased levels of nutrients and sediments, and other stressors, has proven as elusive as defining the nested levels of stress. In the Florida Keys, the effluent of cities, towns, farms, a watershed too vast to control, slowly bleeds into the sea through canals, rivers, and coastal bays. The origin can either be a steady and well-defined point source stream or an effluent that seeps from the land with each rainfall. Both push sediments, nutrients, and contaminants into the sea. More of it upwells from injected sewage, some leaches from shallow septic tanks, urban lawns, agricultural lands, or vacant lots. Some washes into the sea along the west and east coast of Florida, the Everglades, the Mississippi, and lands that are farther downstream. Bits and pieces from a diffuse array of sources contribute to a pervasive level of adverse stress for the reef.

The changes we are witnessing in reefs are echoes of the increased levels of harmful algal blooms in coastal waters, beach closings, and the general global decline in fisheries. The impact of man is extending into the seas. Watershed effluent, runoff from increasingly urbanized landscapes, an unprecedented manipulation by humans, is thought to be responsible for increased levels of nutrients and sediments but the definitive data are not yet in. The data are elusive because reef community metabolism has evolved to rapidly take up and sequester the very nutrients signal we are trying to detect. Increases in algal biomass are thought to reflect increased nutrients but do not constitute proof. Carbonate sediments are almost as hard to follow, so at this time we are left with correlation rather than causality. It is my belief that the declining vitality of reefs is a metric for the health of the oceans, analogous to the coal miner's canary in the cage. They are the fragile harbingers of change warning us of declining oceanic health.

Coral reefs, rain forests, and human civilization are the three most complex communities on Earth. The first two are the most productive natural communities, while humanity, is rapidly encroaching on the entire planet. Reefs are the oldest, having existed since there were organisms with skeletons in the sea.

Modern coral reefs date from about 250 million years before present. Like rain forests, these communities have evolved an ecological logic that allows them to flourish and persist on a planet that is forever changing.

Over enormous spans of evolutionary time, very sophisticated relationships emerge which form the core of biodiversity. The most elaborate ecosystems tend to be found in places that are old, benign, predictable, and frequently rich in solar energy. These ecosystems are very proficient at elemental recycling so that the living portions of the habitat are richer in nutrients, than their surrounding soils or seas. Both reefs and rain forests develop to their highest expressions in habitats that seemingly cannot support luxuriant growth. The soil of rain forests is extremely poor, and the clear warm tropical seas that bath reefs have nutrient levels at or below the level of minimum detection. In this case, more is not always necessarily better.

Human civilization is undergoing an unprecedented population expansion coupled with an economy driven by consumption and profit, as opposed to efficiency and recycling. Humans treat biological resources like agricultural systems in which net production is maximized rather than managing for sustainable yields. Such systems are inherently unstable. They require a constant input of nutrients, very little of which are sequestered in the standing stock or "body" of the ecosystem. They grow at the expense of other systems and greatly increase the entropy of surrounding areas. But, since the earth is finite, this approach cannot continue without increasingly severe degradation of the Biosphere.

One long range vision for future humanity suggests that the incorporation of the logic of natural systems into our mode of living might, perhaps, enable civilization to persist as long as coral reefs and rain forests. Given humanity's commerce-driven dominance of ecosystems, the environmental and long term costs of economic activities need to be reflected in market prices. We must change our present practices, lest we leave only our wastes for future generations.

The very first diving expedition of Calypso was to the Red Sea, beginning the modern study of coral reefs using the Aqualung. It was there that Cousteau became astounded and entranced by the splendor and extravagant beauty of the coral world. In time his concern grew for the careless destruction that our unchecked technological development is spreading into the oceans. His legacy to us is a greater understanding and appreciation for the marvels of life.

### Recommendations for The World Bank

Recognizing that coral reefs may be indicators of oceanic health and that their decline may forebode the decline of the oceans, The World Bank should assume a leadership role in the global conservation of coral reefs for a sustainable future by undertaking the following:

1. Establish an international interdisciplinary working group composed of scientific, technical, and policy experts to ascertain the state of knowledge of coral reef ecosystems and to make recommendations concerning the sustainable future of coral reef ecosystems.
2. Establish collaborations with international space agencies to develop a global capability to map and monitor the distribution of coral reef communities, to ascertain their health, and to identify potential hazards to their future.
3. Support a climate of stimulation for existing activities and fund scientific programs on the health and vitality of coral reef ecosystems, and support efforts to implement sustainable fisheries

practices at all levels.

4. Recognize the dynamics of population growth in coastal areas and focus attention on protecting the ecology of the land-sea margin and watersheds of coastlines and rivers. Address land-based sources of marine pollution, including nutrient and chemical inputs, soil erosion, and forest and agriculture practices.
5. Support the development of an industrial/technological ecology focused both on remediation and an end to pollution of the seas, and develop new environmental management techniques integrating ecology, economics, technology and social sciences ("Ecotechnie") with the goal of significantly reducing pollution in coastal areas, remediating ecological harm, protecting human health, and enhancing human welfare.
6. Expand support for small-scale projects designed to eliminate destructive fishing (i.e. cyanide and dynamite), implement reef surveys and monitoring activities, and protect reefs from physical harm. Work at the national and international level to address fisheries which exploit children, and implement "certification" programs for aquarium fish to assure they are caught in non-harmful manner. Explore the use of microcredit loans for small-scale entrepreneurial activities to promote the sustainable use of coral reef resources.
7. Insure that the knowledge and means for management are transferred to tropical developing nations where most of the world's reefs are located, and assist in developing the capacity of local communities to manage and use these resources in a sustainable manner.
8. Support the establishment of marine protected areas and PSSAs (Particularly Sensitive Sea Areas) to assure the conservation of marine biodiversity.
9. Support the full implementation of the Jakarta Mandate on Marine and Coastal Biodiversity, and the development of a Protocol on Marine Biodiversity Conservation to the Convention on Biological Diversity.



...reply follows...

From tmurdoch@jaguar1.usouthal.edu Thu Jul 23 12:13:07 1998  
Date: Fri, 26 Jun 1998 15:25:04 -0500 (CDT)  
From: "Thaddeus J. Murdoch" [tmurdoch@jaguar1.usouthal.edu]  
To: coral-list@coral.aoml.noaa.gov  
Subject: Re: Reefs at Risk

Recently, several comments have been made regarding the decline and artificial regeneration of the coral assemblages of the Florida Keys:

Phil Dustan - Wed. 24 June 1998:  
> ...the reefs [of the Keys]...will be gone soon...

Les Kaufman - Wed. 24 June 1998:  
> Since acroporids and agariciids are the principal corals with  
> response times and growth rates commensurate with human  
> intervention, should they not be the principle focus of efforts  
> toward [forced-recruitment]?

Given the fact of coral decline in the Keys: The null hypothesis is that all coral species are declining, and are all doing so at an equal rate. This would imply that all coral species are equally affected by whatever large-scale disturbances are perturbing the Florida reef tract.

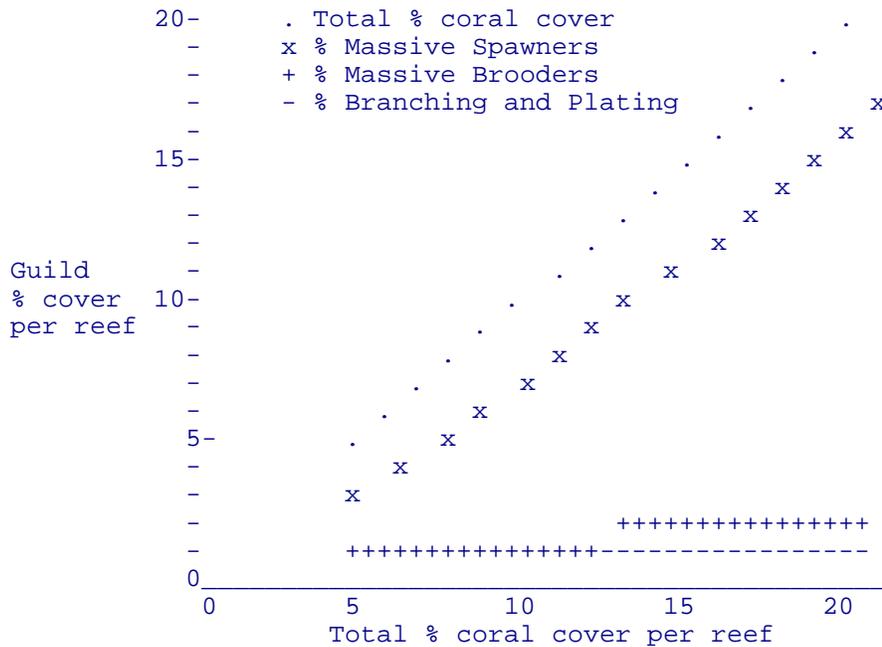
In 1995, as part the Keyswide Coral Reef Expedition, I sampled the coral assemblage structure of 16 spur and groove reefs (15-20 m depth). The sampled reefs were located over the entire Florida reef tract, from Biscayne Bay to the Dry Tortugas.

Coral cover and abundance varied dramatically from reef to reef in a way that suggests that meso-scale gradients in water quality are the primary factors affecting the community composition from reef to reef.

Particularly interesting patterns emerge when the coral cover data are segregated into guilds, with each guild composed of species that share morphology and reproductive mode. The guilds I examined are:

- Mound-like corals that broadcast spawn gametes,
- Mound-like corals that release brooded planula,
- Plating and Foliose Corals (which are mostly brooding corals in the Caribbean),
- Branched corals that broadcast spawn gametes and
- Branched corals that release brooded larvae.

When the % cover of each guild is examined relative to total coral cover on each reef, the following pattern emerges (simplified below):



Massive corals that spawn gametes track changes in total coral cover consistently. Massive corals that brood demonstrate only slightly increased cover on reefs with high total coral cover. All other guilds do not change in cover at all relative to reef to reef differences in total coral cover.

It appears that only the massive spawners are affected by the environmental gradients which control total coral cover on each reef, while all other groups are relatively unaffected (at present). Note: branching corals that spawn gametes (the acroporids) were all but absent from the 20-m deep reefs in 1995,

demonstrating the powerful effects of region-wide disturbances such as disease.

In terms of artificially increasing coral cover in the Keys - the only steps that are likely to work, based on the above, should be improving water quality (locally and regionally) and the forced-recruitment of the massive spawners and the branching spawners. These corals employ rapid, indeterminate growth and high fragmentation rates as a means of dominating a reef. The forced-recruitment of massive brooding corals or the other guilds (which include agariciids) is not likely to lead to an increase in total coral cover on reefs of good environmental quality. These corals are more adapted to utilize patches that are at an early successional state, and generally maintain low cover on these reefs regardless of environmental condition.

Thad Murdoch

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Project Manager  
No-Take Zones of the Florida Keys - Benthic Monitoring Project

Dauphin Island Sea Lab,  
PO Box 369, Dauphin Island, Alabama, 36528, USA.

Tel: (334) 861-7532 Fax: (334) 861-7540

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...reply follows...

From Steneck@maine.maine.edu Thu Jul 23 12:13:13 1998  
Date: Sat, 27 Jun 98 13:52:13 -0400  
From: Bob Steneck [Steneck@maine.maine.edu]  
To: "Thaddeus J. Murdoch" [tmurdoch@jaguar1.usouthal.edu],  
coral-list@coral.aoml.noaa.gov  
Subject: Re: Reefs at Risk

Dear Thaddeus,

I've been interested to learn the results of the 1995 Keyswide Coral Reef Expedition. Your results spawned some questions that perhaps you can answer.

1. How can patterns of decline be determined from a single survey? Do you have a way of estimating the rate of coral mortality?
2. Since percent cover of coral varies for many reasons (including morphogenetic reasons) how do you sort out reefs that always have had low cover from those that have declined to that level recently?
3. Are you surprised at the low acroporid abundance at 20 m? Most geologists who find *Acropora palmata* in their cores assume they grew between 10 m and the surface. In St. Croix in 1973 we

had about a 12 m depth max for that species. Are you sure it's absence at 20 m now demonstrates "the powerful effects of region-wide disturbances such as disease?" (Don't get me wrong, I believe Acroporids have succumbed to disease throughout the region)

4. Perhaps I don't understand your figure but wouldn't that pattern develop if massive spawners are the dominant corals at depths of 20 m. If that's so, wouldn't a similar figure be generated on just about every reef in the Caribbean? Excuse me if I misunderstood what you meant.

Sincerely,

Bob Steneck

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Robert S. Steneck  
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The School of Marine Sciences Web site:  
[http:// www.ume.maine.edu/~marine/marine.html](http://www.ume.maine.edu/~marine/marine.html)

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...reply follows...

From [tmurdoch@jaguar1.usouthal.edu](mailto:tmurdoch@jaguar1.usouthal.edu) Thu Jul 23 12:13:19 1998  
Date: Sat, 27 Jun 1998 21:38:31 -0500 (CDT)  
From: "Thaddeus J. Murdoch" [[tmurdoch@jaguar1.usouthal.edu](mailto:tmurdoch@jaguar1.usouthal.edu)]  
To: Bob Steneck [[Steneck@maine.maine.edu](mailto:Steneck@maine.maine.edu)]  
Cc: [coral-list@coral.aoml.noaa.gov](mailto:coral-list@coral.aoml.noaa.gov)  
Subject: Re: Reefs at Risk - Guilds questions

Dear Dr. Steneck,

In answer to your questions:

- > 1. How can patterns of decline be determined from a single survey?

It was not my intent to show guild-specific differences in decline over time, although I would love to be able to do so. Additional surveys of the entire reef tract are needed to accomplish this.

- > 2. Since percent cover of coral varies for many reasons (including  
> morphogenetic reasons) how do you sort out reefs that always have had low  
> cover from those that have declined to that level recently?

My intent was to examine whether all coral guilds responded equally to whatever disturbances resulted in the reef-to-reef differences in total coral cover. If all of the guilds were equally affected by the slew of disturbances that assaulted each reef up to the point in time when we sampled, one could reasonably expect to see all guilds demonstrate higher cover on reefs with high total coral cover, and lower cover on the reefs with low total coral cover, when compared over the entire reef tract as a whole.

The results, on the other hand, show that only the massive spawners demonstrate coral cover which varies linearly with total coral cover per reef. All other guilds do not vary. In other words, reefs which we would qualitatively classify as healthy (i.e. high coral cover) have the SAME cover of massive brooders, plating corals and branching brooders as a reef we would qualitatively classify as unhealthy (hardgrounds too!). This implies not only that all guilds do not respond equally to whatever factors determine total coral cover from reef to reef, but that most guilds are hardly affected at all, as long as there is rock to live on.

The next question is - Have only the massive spawning corals and the branching spawners been declining over Recent time in the Keys, or have all guilds? The above results indicate that all guilds might not have been declining. I don't have the data to answer this question, yet. Perhaps others do.

> 3. Are you surprised at the low acroporid abundance at 20 m? etc..

Sorry, I should have been more specific. What I meant was that *Acropora cervicornis* was absent. Many of the reefs we sampled had large amounts of *A. cervicornis* rubble on them, implying that the reefs had possessed *A. cervicornis* in the past. I think that the graph I presented would have looked different in regards to this guild had we sampled a few decades ago.

> 4. Perhaps I don't understand your figure but wouldn't that pattern  
> develop if massive spawners are the dominant corals at depths of 20 m.

They are the dominant corals. Since the massive spawners (and branched spawners) possess the properties that make them the dominant corals, and since they appear the most affected by water quality, the corals of these guilds are the best choice for forced-recruitment in the Florida Keys. Subordinate guilds, with slower growth etc., are less likely to increase total coral cover over an entire reef, even though they are better able to cope with poor water quality.

> If that's so, wouldn't a similar figure be generated on just about every  
> reef in the Caribbean?

I would be thrilled if these results scaled up to predict the guild composition of the deeper spur-and-groove reefs over the entire Caribbean, relative to reef-by-reef differences in disturbance history.

On a separate issue, I am not sure we need to resort to forced-recruitment in the Keys at the moment. For instance, the sexually generated offspring of *A. cervicornis* appear to be recruiting back to the Keys on their own. However, steps to improve the water quality of the Caribbean should be taken immediately.

Respectfully,

Thad Murdoch

---

Project Manager  
No-Take Zones of the Florida Keys - Benthic Monitoring Project

Dauphin Island Sea Lab,  
PO Box 369, Dauphin Island, Alabama, 36528, USA.

Tel: (334) 861-7532 Fax: (334) 861-7540

---

...reply follows...

From rcgregor@ust.hk Thu Jul 23 12:13:50 1998  
Date: Mon, 29 Jun 1998 18:39:39 +0800  
From: Gregor Hodgson [rcgregor@ust.hk]  
To: coral-list@coral.aoml.noaa.gov  
Subject: Adopt-a-Reef

Dear Colleagues,

The coral-list recently has been the site of an important discussion some of which could fall under the question of, "What ACTION should we be taking to 'help' Caribbean reefs." Some colleagues seem to believe that having a complete scientific understanding of reef ecology and dynamics is needed before we can do anything sensible, while others feel that 'more monitoring' is a pointless task.

I believe that participation in community-based monitoring programs such as Reef Check is THE PRIMARY solution to coral reef problems because it is the first step towards developing an "adopt-a-reef" attitude among local residents wherever reefs are found. By taking part in monitoring, citizens develop that sense of stewardship that is currently lacking. As the number of educated stakeholders increases, so does the public pressure on governments to act to stop unsustainable activities both on land and at sea that lead to reef damage and to support conservation measures such as MPA creation. It was not too many years ago that oil drilling leases were being offered on the GBR. This would not be possible today because a sizable percentage of Australians now have a strong sense of stewardship for the reef.

Regarding rehabilitation, the old adage, "an ounce of prevention is worth a pound of cure" applies well to reefs -- reef rehabilitation is usually expensive (see e.g. International Workshop on the Rehabilitation of Degraded Coastal Systems, Phuket, 19-24 January, 1998. For details contact: [\[a.j.edwards@ncl.ac.uk\]](mailto:a.j.edwards@ncl.ac.uk)).

Of the funding available for coral reef research and monitoring, we will always need a balance of community-based monitoring, intensive and taxonomically detailed "government" monitoring, and basic research into coral reef ecology and the response of reefs to anthropogenic and natural perturbations.

However, without the crucial step of building stewardship, no amount of government regulation, MPA

creation or expensive rehabilitation will help coral reefs, regardless of the quality of our scientific understanding. So, if you are a scientist -- "Ask not what coral reefs can do for your publication record, but ask what you can do to educate the public about coral reefs."

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Gregor Hodgson, PhD  
Institute for Environment and Sustainable Development  
Hong Kong University of Science and Technology  
Clearwater Bay, Hong Kong  
Tel: (852) 2358-8568 Fax: (852) 2358-1582  
Email: <[rcgregor@ust.hk](mailto:rcgregor@ust.hk)>  
Reef Check website: [www.ust.hk/~webrc/ReefCheck/reef.html](http://www.ust.hk/~webrc/ReefCheck/reef.html)

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...reply follows...

From osha@pobox.com Thu Jul 23 12:14:10 1998  
Date: Mon, 29 Jun 1998 08:27:10 -0500  
From: Osha Gray Davidson [osha@pobox.com]  
To: coral-list@coral.aoml.noaa.gov  
Subject: Gregor Hodgson's message

Gregor Hodgson wrote:

- > I believe that participation in community-based monitoring programs such
- > as Reef Check is THE PRIMARY solution to coral reef problems because it
- > is the first step towards developing an "adopt-a-reef" attitude among
- > local residents wherever reefs are found.

While Gregor did state that it was just an opinion (and it makes sense that such a program is important) the claim that community-based monitoring is THE PRIMARY solution to coral reef problems seems a bit overstated. While there may well be lots of reefs for which this holds true, aren't there also many others for which other solutions are needed? For example, reefs that have few/no local residents but which are suffering from anthropogenic degradation. And even in cases in which building a local sense of stewardship is primary, monitoring may not be the most efficient method. With problems and conditions so diverse, it seems (my opinion) that there is no "primary" solution. Perhaps, instead, there are several equally important "solutions" that vary according to place. Or, more difficult still, for a given reef there may be several equally important steps that need to be taken at the same time.

Osha

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Iowa City, IA 52240 USA

Ph: 319-338-4778

Fax: 319-338-8606  
[osha@pobox.com](mailto:osha@pobox.com)  
Scholar Affiliate, University of Iowa

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...reply follows...

From [gene@wayback.er.usgs.gov](mailto:gene@wayback.er.usgs.gov) Thu Jul 23 12:14:41 1998  
Date: Mon, 29 Jun 1998 15:16:42 -0400  
From: Gene Shinn [[gene@wayback.er.usgs.gov](mailto:gene@wayback.er.usgs.gov)]  
To: [coral-list@coral.aoml.noaa.gov](mailto:coral-list@coral.aoml.noaa.gov)  
Subject: Coral demise

Not wishing to add to or detract from the recent "chicken little" debates, I offer some recent observations that will be of interest to many of you. On June 25, 1998 I revisited and photographed the *Montastrea annularis* head on Grecian Rocks off Key Largo that I have photographed regularly since 1961. The head has become smaller and gorgonians are continuing to flourish and encroach where in the 1960s and 70s vast thickets of *A. cervicornis* flourished. There were some small clumps of approximately 2-year-old *A. cervicornis* nearby.

The Christ statue site at Key Largo Dry Rocks was also visited because within visual range (north west of the statue) there is a huge head of *Colpophyllia natans*. This head has thrived in spite of diver impact. One can only assume that this head receives more knocks, kicks and bumps than any other coral in the Keys. However, what was expected 20 years ago has finally happened. The upper 1/4 to 1/3 of that head is now dead (when death occurred or whether it was caused by divers is not known). There were similar but smaller heads in 6 m of water (below kicking depth) 100 m or more away from the statue that were also dead and/or infected by active black band disease. Bleaching was not apparent at the sites visited. The condition of Florida reefs does not appear to be improving in spite of the millions spent researching and monitoring the problem.

"If we lose our capacity to be wrong, we are not doing the business of science" Charles L. Drake

Gene Shinn USGS Center for Coastal Geology 600 4th St. South St. Petersburg, FL 33701	email: <a href="mailto:eshinn@usgs.gov">eshinn@usgs.gov</a> voice: (813) 893-3100 x3030 fax: (813) 893-3333
--	---

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...reply follows...

From [BPrecht@kennesaw.Lawco.com](mailto:BPrecht@kennesaw.Lawco.com) Thu Jul 23 12:14:50 1998  
Date: Mon, 29 Jun 1998 18:30:20 -0400  
From: "Precht,Bill" [[BPrecht@kennesaw.Lawco.com](mailto:BPrecht@kennesaw.Lawco.com)]

To: coral-list@coral.aoml.noaa.gov  
Subject: Reefs at Risk.

Dear Group:

I just returned to find my email inbox loaded with various views on this question of "reefs at risk"

Since a few of the examples discussed included some of my own research and/or research areas, I felt that I needed to throw in my two-cents worth.

Recently, I was having a discussion with Sen. Bob Graham (FL) with regards to the "coral reef crisis" in Florida. Cutting to the quick, Sen. Graham asked me if what was going on in Florida was happening elsewhere throughout the Caribbean and western Atlantic? The answer is yes. An emphatic YES! Although this in itself is very disturbing, trying to blame Florida's coral reef woes on the sugar industry or primitive septic systems in the Keys is out of place and off target. I'm not saying these should not be included in a comprehensive management plan for a sustainable south Florida...they should. But as Steven Miller has made clear the "chicken little" approach, while it sells memberships to The Cousteau Society, Reef Relief and others, does not offer much in the way of rigorous quality science or to finding common ground for solutions... and these should not be mutually exclusive... I hope quality science will be at the forefront of future management decisions and solutions.

The same increases in macroalgae we are seeing across the Florida reef tract are being observed throughout the region (Almost without exception!). The two prevailing paradigms for this increase in seaweeds include the loss of herbivores(overfishing) and nutrification (decreasing water quality). Trying to tease out the most important of these two on a regional scale (finding the smoking gun) has proved to be troublesome and problematic. Certainly, each of these are important on some reefs, while on others both are working in concert towards reef decline. However, on a regional basis the one common link has been declining coral cover. Specifically, the mortality of the acroporids on a regional scale. Over the past two decades these corals have succumbed to disease (white syndromes) as well as physical damage thereby opening space for the colonization by rapidly recruiting and fast growing algal species. This has occurred on reefs far from population centers on some of the most "pristine" and remote reefs of the entire region. In the early 1980's as White Band Disease obliterated *A. cervicornis* on the Florida reef tract, the same malaise affected reefs of the eastern Bahamas. These Bahamian reefs are bathed in some of the most oligotrophic waters of the western Atlantic. No nearby river systems, no burgeoning population on these islands, no deforestation problems, no sugarcane industry, plenty of herbivorous fish, etc.... In comparing similar habitats (apples to apples) these reefs look no different today than their Florida counterparts...lots of *A. cervicornis* rubble covered with macroalgae (in fact as Bob Steneck points out many of these reefs are in far worse shape than the Florida examples), while stands of other corals such as *Montastrea* spp. appear to be thriving. This is the same in Bonaire, Belize, Columbia, and so on... Rich Aronson and I have been struggling with this question for the last decade and a half and have just completed a paper that discusses this in some detail (Aronson and Precht, in-press, Evolutionary paleoecology of Caribbean coral reefs in Allmon and Bottjer (eds).The Ecological Context of Macroevolutionary Change. Columbia University Press).

Certainly, Florida's reefs are in crisis...but than so is every reef in the Caribbean. Trying to pick the 12 most endangered is way too subjective, even with a list of discriminators...everybody has a favorite reef which brings me the second part of my discussion... The Reefs of Belize.

First off I'd like to clarify one of Les Kaufman's points in an earlier discussion. Les stated "Belize was

unusual in that when the acorporids began to vanish, there was an endemic agariciid...that could serve as a partial functional replacement, and it did." Although he is partially correct (see Aronson and Precht, 1997, Stasis, biological disturbance, and community structure of a Holocene coral reef: Paleobiology 23(3):326-346.), the reefs that were replaced by agariciids were lagoonal reef complexes in central Belize. The main Belizean Barrier Reef and offshore Atolls, lost *A.cervicornis* during more or less the same time period. However, on these reefs the replacement species was macroalgae just like most of the rest of the Caribbean including Florida. This coral-to-macroalgal scenario for Belize will be shown in an upcoming "reef site" in CORAL REEFS by McClanahan et al.

Now turning to the reefs of southern Belize. The Maya hinterland is being deforested at a staggering rate, mostly for agri-development. This has dramatically increased the amount of sediment laden water entering the southern Belize lagoon. This coupled with the southward sloping configuration of the Belize platform, puts reefs that are already submerged (incipiently drowned) to a depth of >8m, in a position where they will founder and drown in the face of deleterious water quality. Without holistic management of the Maya Mountain watershed the effects on reefs from the southern Belize lagoon will be devastating. (Also remember that the fast growing *A. cervicornis* has been almost completely decimated from these reefs as well due to WBD)

So where do we go from here?????

Best Management Practices must be employed both on local and regional scales to be most effective. We must value all reef areas equally and not score Florida above Belize or vice versa... We must understand the pivotal role of coral mortality, especially mortality due to disease. We must understand the causes of coral disease... especially if there is a link to human's which many suspect... We must understand the recruitment and regeneration of coral species in the wake of these disturbances... We must be able to tease out those things that can be managed with those that can not... and finally WE MUST STOP POINTING OUR COLLECTIVE FINGERS AT POSSIBLE CAUSES UNTIL WE ARE SCIENTIFICALLY SURE THERE IS A LINK TO THE SYMPTOM. Citing decreasing water quality as the main issue is a cop out. Plaudits to Thad Murdoch for an interesting review of his Keys Wide data.

Bill Precht  
LAW Engineering & Environmental Services, Inc.  
5845 NW 158th Street  
Miami Lakes, FL 33014  
ph (305)826-5588  
fax (305) 826-1799

---

...reply follows...

From pmuller@seas.marine.usf.edu Thu Jul 23 12:15:00 1998  
Date: Mon, 29 Jun 1998 20:34:44 -0400 (EDT)  
From: Pam Muller [pmuller@seas.marine.usf.edu]  
To: "Precht,Bill" [BPrecht@kennesaw.Lawco.com]  
Cc: coral-list@coral.aoml.noaa.gov  
Subject: Re: Reefs at Risk.

Three points:

Point 1. The 1917 flu epidemic that killed literally millions of people worldwide, started, at least according to one theory, in a prisoner of war camp. That is, a new pathogen, once it gets into a population with minimal resistance, doesn't require that its victims be stressed, only that they lack resistance (the current spread of HIV is another pertinent example).

Thus, there is no reason to expect that the spread of WBD and other new pathogens like the possible Diadema virus, once they get into a region, have anything to do with the vitality of the population affected.

Point 2. Despite an unfortunate "The" in the Florida Keys section of the Reefs at Risk document, I don't know anyone who thinks declining water quality is the only problem. To quote from the Reefs at Risk document "The coral reefs of the Florida Keys exemplify the complexity of threats to reef resources".

On the other hand, humans have doubled the rate at which fixed nitrogen is entering terrestrial ecosystems (e.g., Vitousek et al 1997, Science and several other recent papers). To assume that we haven't similarly altered nitrogen flux to aquatic systems is unrealistic. Of course, understanding the spectrum of consequences of possibly doubling the annual rate of nitrogen flux to coastal ecosystems is obviously not a trivial matter, especially when we are adding so many other wonderful things to our atmosphere and coastal waters at the same time.

Point 3. I suspect that looking for "the smoking gun" in the Florida Keys is analogous to searching for The Holy Grail. I doubt that you will find it, but hopefully you will learn something along the way.

Pamela Hallock Muller  
Department of Marine Science  
University of South Florida  
140 Seventh Avenue South  
St. Petersburg, FL 33701 USA  
[pmuller@marine.usf.edu](mailto:pmuller@marine.usf.edu)  
Phone: 813-553-1567  
FAX: 813-553-1189

"Discovery consists of seeing what everybody has seen and thinking what nobody has thought." - Albert Szent-Gyorgyi -

---

...reply follows...

From MERPM@aol.com Thu Jul 23 12:15:04 1998  
Date: Mon, 29 Jun 1998 20:40:52 EDT  
From: MERPM@aol.com  
To: coral-list@coral.aoml.noaa.gov  
Cc: wcsfl@afn.org

Subject: Reefs at Risk

While it may not be great science to say that the leaking septic systems of the Keys and the nutrient addition to Florida Bay, etc., from agriculture in the Everglades are two of the probable major causes of reef degradation in the Keys it seems highly unlikely that they are not. Human populations and agricultural production have expanded tremendously in all of the areas mentioned in the last posting about this topic....Belize, Colombia, the lesser and greater Antilles, Honduras, Florida, etc. Reefs in all of these locations have suffered due to increases in agricultural runoff and domestic sewage, raw sewage in most cases, inputs. I don't believe the science is lacking...fertilizer and sediments from any source harm reefs. It is happening everywhere we look because human populations have expanded, everywhere, beyond the capacity of the land to absorb our wastes...thus the excess flows to the sea. The concept is very simple and, in most areas, waiting for additional research to be completed is in itself a major threat to reefs. We need to move from pretending that we don't know what is killing reefs to taking restorative measures or protective measures to prevent further losses.

Mike Marshall

---

...reply follows...

From bmill@soest.hawaii.edu Thu Jul 23 12:15:16 1998  
Date: Mon, 29 Jun 1998 14:57:41 -1000 (HST)  
From: Robert Miller [bmill@soest.hawaii.edu]  
To: "Precht,Bill" [BPrecht@kennesaw.Lawco.com]  
Cc: coral-list@coral.aoml.noaa.gov  
Subject: Re: Reefs at Risk.

In reply to Bill Precht's comments:

I have been to Belize as well as the Bahamas, and have a very hard time believing that the reefs there are "no different" than those of the Keys. Citing an upcoming "reef site" is not the "rigorous science" that Precht himself cries out for. Moreover, blaming declining water quality for coral decline is not blind "finger pointing" - there is a mechanism - increased algae growth in the presence of increased nutrients, and evidence of pattern (e.g. Cuet et al. 1988). This is not the only factor that biologists are pointing to, either; overfishing, for instance, is also often indicted by them as well as the environmentalists that Precht apparently disdains (e.g., Cousteau Society). The fact is, things are much more likely to get done by people like them than by decades of "teasing apart" of data that are hopelessly confounded and work in a complex environment that isn't amenable to unequivocal field experiments. All the "musts" that he cites will unfortunately never be understood in totality. Don't get me wrong, obviously we must try, but things must be done before even good understanding of some issues is reached. The precautionary principal applies here. Finally, why all the reference to big sugar? Is it possible, Bill, that LAW might actually work for sugar companies? That would certainly explain why you had Bob Graham's ear!

Robert Miller  
University of Massachusetts Boston  
100 Morrissey Boulevard

Boston Massachusetts 02125  
(617)287-6638

---

...reply follows...

From delbeek@hawaii.edu Thu Jul 23 12:15:23 1998  
Date: Mon, 29 Jun 1998 20:52:30 -1000  
From: "J. Charles Delbeek" [delbeek@hawaii.edu]  
To: coral-list@coral.aoml.noaa.gov  
Subject: Re: Reefs at Risk

I seem to recall reading a recent paper on a study of nutrient levels off of Key Largo and lower down in the keys. Although nutrient levels inshore were found to be slightly elevated, those on the outer reef tracts were found to be quite low. I don't see how you can make the assertion that nutrient run-off is causing problems on these outer reefs when the levels are so low?

However, having said that, it brings to mind the observations that many home aquarists have made and also illustrated by the microcosm systems at the Smithsonian Institute using algal turf scrubbers, that despite very low levels of nitrate and phosphate in the water column algal growth can still be quite substantial. In light of my experiences in closed systems I would have to propose that lack of herbivores is a greater contributing factor to algal growth on Caribbean reefs than high nutrients. I think if coral researchers spent some time working with closed "mini-reef" ecosystems, they might gain a new perspective on coral reefs and how they function in situ, as well as coral wasting diseases, which BTW are also being encountered by home hobbyists.

J. Charles Delbeek M.Sc.  
Aquarium Biologist  
Waikiki Aquarium

"The fact that my physiology differs from yours pleases me to no end."  
Mr. Spock

(Note: Marshall's entire message was quoted in the original text of this message. To go back to Marshall's message [click here](#).)

---

...reply follows...

From lesk@bio.bu.edu Thu Jul 23 12:16:51 1998  
Date: Tue, 30 Jun 1998 09:10:55 -0400  
From: Les Kaufman [lesk@bio.bu.edu]  
To: coral-list@coral.aoml.noaa.gov

Subject: Bill Precht's reply

Thank you, Bill, for that discussion of Belize. One minor point, to file under "blind men and the elephant." My comments re: Belize were from personal observations at Tobacco Reef and South Water Caye, as well as on mid-shelf reefs around Wee Wee and the Pelicans. Tobacco and South Water (the spots I visited in 1997) sported luxuriant spurs of *Agaricia tenuifolia*, with isolated patches of *A. palmata* in shallow and scattered *A. cervicornis* sign and a few still-living, though embattled colonies. It's likely that heterogeneity in exposure and local conditions contaminate cross-shelf comparisons here, just as they do on the Great Barrier Reef. I just connected the few places I'd been to with the Aronson and Precht story, and they happened to rhyme. Bears a frightening resemblance to religion.

On a graver note, after all this discussion of the importance of interacting factors, in explaining our collective wisdom to the public shouldn't we continually emphasize that whatever the unique combination of factors responsible for the death of a specific reef, the prevailing factors include several that we CAN do a great deal about? Even if overfishing and eutrophication are not the universal causes of reef death this year, there is no excuse for them in the first place, and ameliorating them will hasten reef recovery in any event.

Les Kaufman  
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5 Cummington Street  
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phone: 617-353-5560  
fax: 617-353-6340

"I believe we are on an irreversible trend toward more freedom and democracy... but that could change."

-Vice President Dan Quayle, 5/22/89

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...reply follows...

From Ron.Hill@noaa.gov Thu Jul 23 12:16:56 1998  
Date: 30 Jun 1998 09:08:33 -0400  
From: Ron Hill [Ron.Hill@noaa.gov]  
To: BPrecht@kennesaw.Lawco.com, coral-list@coral.aoml.noaa.gov  
Subject: Re:Reefs at Risk.

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Subject: Reefs at Risk.  
Author: BPrecht@kennesaw.Lawco.com

Date: 6/29/98 7:07 PM

[original message]

Although this in itself is very disturbing, trying to blame Florida's coral reef woes on the sugar industry or primitive septic systems in the Keys is out of place and off target.

Now turning to the reefs of southern Belize...where they will founder and drown in the face of deleterious water quality. Without holistic management of the Maya Mountain watershed the effects on reefs from the southern Belize lagoon will be devastating.

...We must be able to tease out those things that can be managed with those that can not... and finally WE MUST STOP POINTING OUR COLLECTIVE FINGERS AT POSSIBLE CAUSES UNTIL WE ARE SCIENTIFICALLY SURE THERE IS A LINK TO THE SYMPTOM. Citing decreasing water quality as the main issue is a cop out. Plaudits to Thad Murdoch for an interesting review of his Keys Wide data.

Bill Precht

\*\*\*Question: Why is it acceptable to point fingers at one cause of water degradation far from our Florida Keys, i.e., deforestation in the Mayan hinterland, but not acceptable to point fingers at a source of decreased water quality affecting reefs much closer to home, i.e., the sugar industry that operates on deforested lands upstream from the Keys?

While decreasing water quality may not be the only cause for reef degradation it is certainly one of the major contributing factors that is manifested in a variety of ways (over-nuttrification, sedimentation, transport of pollutants/pathogens, etc.) and comes from a wide variety of sources. All potential sources of degradation should be examined and addressed. Water quality problems are a source of degradation that can be improved if we are willing to do the right things.

ron

---

...reply follows...

From kclark@iu.net Thu Jul 23 12:17:26 1998  
Date: Tue, 30 Jun 1998 08:51:23 -0400  
From: Kerry B Clark [kclark@iu.net]  
To: coral-list@coral.aoml.noaa.gov  
Subject: Re: Reefs at Risk--nutrients

J. Charles Delbeek wrote:

> I seem to recall reading a recent paper on a study of nutrient levels off  
> of Key Largo and lower down in the keys. Although nutrient levels inshore  
> were found to be slightly elevated, those on the outer reef tracts were  
> found to be quite low. I don't see how you can make the assertion that

- > nutrient run-off is causing problems on these outer reefs when the levels
- > are so low?

Use of standing stock (instantaneous measurements) to estimate nutrient dynamics is a classic problem in ecosystem analysis, because rapid uptake can lower the standing stock even if input is high. Enzymes involved in nutrient uptake of tropical algae have a high nutrient binding affinity, so one should expect a priori that uptake should be very rapid. Turnover rates of nutrients can also increase without significantly affecting standing stock. Thus, one cannot conclude from low "levels" of nutrients that nutrient runoff is not a factor in algal overgrowth. In combination with decreased herbivore populations, as noted, even very slight elevations could lead to overgrowth. If inshore levels are "slightly elevated" then one must ask what happens to these nutrients. Rapid uptake as these waters flow over the reefs is a reasonable explanation.

We also tend to assume that macronutrients are always the limiting factor, when micronutrients/trace elements can also contribute to algal blooms. These are less frequently considered in causes of algal growth. Trace elements are also components of agricultural runoff and of human sewage.  
-Kerry Clark

---

Kerry Bruce Clark, Ph.D., F.A.A.A.S.  
Professor of Biological Sciences, Assoc. Dept. Head (Graduate Coordinator)  
Florida Institute of Technology, Melbourne, FL 32901-6988  
Phone 1-407-674-8195  
-- Proud Member of the Impoverished Gentry --  
Visit the Cambrian in 3D at "<http://users.aol.com/kbclark/cambrian>"  
Metazoa website at "<http://www.metazoa.com>"  
"Bytes of Nature," publisher of quality natural history software

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...reply follows...

From pmuller@seas.marine.usf.edu Thu Jul 23 12:17:32 1998  
Date: Tue, 30 Jun 1998 09:29:56 -0400 (EDT)  
From: Pam Muller [pmuller@seas.marine.usf.edu]  
To: coral-list@coral.aoml.noaa.gov  
Subject: Re: Reefs at Risk

Laws and Redalje (1979), *Pacific Science*, 33: 129-144, studying Kaneohe Bay, found that measuring inorganic nutrients is about the least effective way of determining nutrient pollution. To quote their final sentence (p. 142): "In short, in nutrient-enriched systems much of the added nutrient is likely to become incorporated into seston due to rapid uptake by phytoplankton, and therefore particulate concentrations such as chl a, ATP and PN are likely to provide more sensitive and more widely applicable indices of eutrophication than do inorganic nutrient concentrations."

And that was in an enclosed bay which experienced major changes in benthic community structure. On an open shelf, as long as the benthic community can assimilate the increased nutrient flux by increasing

biomass (especially algal and heterotroph), there is no reason to predict an increase in dissolved inorganic nutrients in the water column or a buildup of detrital organic carbon in the sediments.

Pamela Hallock Muller  
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[pmuller@marine.usf.edu](mailto:pmuller@marine.usf.edu)  
Phone: 813-553-1567  
FAX: 813-553-1189

"Discovery consists of seeing what everybody has seen and thinking what nobody has thought." - Albert Szent-Gyorgyi -



(Note: Delbeek's entire message, including Marshall's message, was quoted in the original text of this message. To go back to Delbeek's message [click here](#). To go back to Marshall's message [click here](#).)

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...reply follows...

From BPrecht@kennesaw.Lawco.com Thu Jul 23 12:17:46 1998  
Date: Tue, 30 Jun 1998 11:12:23 -0400  
From: "Precht,Bill" [BPrecht@kennesaw.Lawco.com]  
To: lesk@bio.bu.edu  
Cc: coral-list@coral.aoml.noaa.gov  
Subject: RE: Bill Precht's reply

Les:

Thank you... and I could not agree more

Bill

(Note: Kaufman's message on June 30 was quoted in its entirety in the original text of this message. To go back to that message [click here](#).)

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...reply follows...

From BPrecht@kennesaw.Lawco.com Thu Jul 23 12:18:19 1998

Date: Tue, 30 Jun 1998 11:42:04 -0400  
From: "Precht,Bill" [BPrecht@kennesaw.Lawco.com]  
To: Robert Miller [bmiller@soest.hawaii.edu],  
"Precht,Bill" [BPrecht@kennesaw.Lawco.com]  
Cc: coral-list@coral.aoml.noaa.gov  
Subject: RE: Reefs at Risk.

Robert & Group:

First off let me say that I never expected such a varied and in one case "hostile" response to my comments...be that as it may...I will not address all the comments, it was meant to be thought provoking, and obviously it was. However, let me clarify a few things just so everyone knows from where I am coming.

Bob Miller, you can take a swing at my scientific interpretations but be very careful when you start talking about my ethics.

1. Yes, I do work for LAW (an ENVIRONMENTAL CONSULTING FIRM).
2. No - we do not work for big sugar or large private developers here in south Florida. In fact we just turned down a large project for "big sugar" for an endangered and threatened species recovery plan due to the potential conflict of interest we would have with our other clients. Most of these clients are Governmental - including the US National Park Service, ARMY Corps of Engineers and others. In my job as the Natural Resources Manager for the region, I am mostly responsible for wetland and coastal restoration programs. This includes LAW's participation in the Everglades Restoration Initiative, beach nourishment programs, Coral Reef Restoration programs related to ship groundings and other anthropogenic sources, etc.... To date, all the reef cases we have worked on have been for the trustee's and not the responsible parties.
3. My reason for talking with Sen. Graham (Florida's Environmental Senator) is personal and not business. He is my neighbor here in Miami Lakes, he is a member of my church, and he is a SCUBA diver who loves the reefs of Florida. No more - no less.
4. I do not disdain Environmental NGO's. especially the Cousteau Society. From the time I can remember.. the thought of being a visiting scientist on the Calypso..... well I won't wax sentimental, you get the point. However, we do need to build a sense of stewardship with the non-scientific community, and NGO's are a vital way of doing this. My point yesterday, was with "chicken little" - yes- Florida's reefs are in crisis, but why? If it is a Caribbean wide water quality issue (as I suspect it very well may be) than we need to come to terms with how to manage these intra-ocean / multi-national problems... and we need to have the political will to do it.

As far as big sugar goes for Florida - they are an easy target for the environmental troops to rally around. They are their own worst enemy here in Florida by often having a inflexible attitude to the point of arrogance. However, water quality studies from north-to-south, through the gut of the Everglades and into Florida Bay does not show that they are responsible for the water quality woes on the south end (the estuarine and marine end) of the system. It is well documented what the problems are in the Everglades Agricultural Area. We need to be careful when we make leaps of faith.

As I stated yesterday... Sugar - septic - population growth - all need to be addressed in the overall plan for a sustainable south Florida.

5. As far as citing a "reef site" as rigorous science...it was just an example showing that the Belizean Barrier Reef has undergone a similar change from coral-to-macroalgae as some other areas. I did not want to get into too much detail on that topic as it is probably best left for a refereed journal, but since you asked.....I will follow with a separate detailed message, with data, later today.

Bill Precht

"The nation behaves well if it treats the natural resources as assets which it must turn over to the next generation increased and not impaired in value."

Theodore Roosevelt

(Note: Robert Miller's entire message was quoted in the original text. To go back to that message [click here](#).)

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...reply follows...

From J.MCMANUS@cgnet.com Thu Jul 23 12:18:26 1998  
Date: Wed, 01 Jul 1998 16:54:00 -0700 (PDT)  
From: John McManus [J.MCMANUS@cgnet.com]  
To: "coral-list@reef.aoml.noaa.gov" [coral-list@coral.aoml.noaa.gov]  
Cc: "Meryl J. Williams" [M.J.WILLIAMS@cgnet.com],  
Peter Gardiner [P.GARDINER@cgnet.com],  
Sheila Vergara [S.VERGARA@cgnet.com]  
Subject: RE: Reefs at Risk

1 July 1998

Dear Coral-listers:

I just returned for a few days amid a series of trips. I'm pleased to see there has been some healthy debate over the "Reefs at Risk" report. It was obviously our first shot at the global situation analysis. We are already hard at work arranging for follow-up versions over the next few years. We hope that we can count on all of you to help produce an increasingly accurate picture of the state of the reefs and the changes that are occurring.

Three important aspects of the analysis were the model, the consultations and the data. We will strive to improve the first by figuring out various options for weighting and incorporating the most meaningful variables. We are hoping to dig up support for future consultations to involve more regional experts, perhaps via regional meetings. Finally, we really need more data with which to adjust the model.

We encourage inputs in all three aspects. The model is reasonably well-explained in the report. Please

feel free to send in suggestions to any of the authors for improving the model. If we find support for regional meetings, we will call on a larger consultative body to help out. However, in the area of data availability we need help from a wide range of coral-listers and your contacts. The world still holds tens of thousands of reef reports (environmental impact studies, technical reports, etc.) which we do not have in ReefBase. We are moving increasingly into consolidating and disseminating large sets of raw survey data. More surveys need doing. We also need more reports of stresses affecting reefs, such as appear in Coral-list. Careful follow-up and formal publication will raise the confidence levels and utility of the reports. We need both "forward observers" (sport divers) and "heavy artillery" (scientists, managers, etc.) in this effort.

For more information on how to help with ReefBase and related activities, please write to [<reefbase@cgnet.com>](mailto:reefbase@cgnet.com).

Sincerely,

Dr John W McManus  
ReefBase Project Leader  
Aquatic Environments Program  
International Center for Living Aquatic Resources Management (ICLARM)  
MCPO Box 2631, Makati City, Philippines 0718  
[<j.mcmanus@cgnet.com>](mailto:j.mcmanus@cgnet.com)  
<http://www.reefbase.org/>

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...reply follows...

From cnidaria@earthlink.net Thu Jul 23 12:19:00 1998  
Date: Thu, 2 Jul 1998 08:04:15 -0700 (PDT)  
From: "James M. Cervino" [cnidaria@earthlink.net]  
To: coral-list@coral.aoml.noaa.gov

Reefs At Risk

My students and myself have been reading the debate on the coral list server regarding the problems reefs are facing, and we had some questions:

1. I have been diving the Caribbean since 1979, and the Pacific since 1990. We have seen the exponentially expanding human populations and tourist hotels grow in numbers in the past 15 years, and along with this growth we have seen the steady growth of macro-algae smothering the corals leading to coastal eutrophication . None of these islands have sewage treatment plants, and the islands that don't have septic tank overflows, dump sewage directly into the water. I don't even think there is a debate as to whether this direct dumping of sewage is causing such high nutrient loads along these coasts and shallow lagoons, or is there?
2. Are we saying in situations such as this, up-welling of nutrients from the deep oceans, and sewage from anthropogenic sources are equally causing the demise of coral cover?

3. Can someone honestly say that fertilizers and anthropogenic waste, whether it be direct or from leaky septic is not part of the major problem on these islands and southern Florida??
4. Regarding Fl. : What about the river of sand, a geological formation called the Long Key Formation, that was deposited along the Florida peninsula 3-5 million yrs ago. Larry Brand has claimed that this is an ideal way for phosphate laden water to move through unchanged, thus leaking under the Florida Bay, is this not true?? It makes sense! Is this not causing the demise of coral cover from coastal eutrophication??
5. Studies by Lapointe and Tomasko have shown that increased water column nutrient availability typically results in greater epiphyte levels on seagrass blades. Nutrient-induced increases in epiphyte coverage decrease the amount of light that seagrass blades and corals tissue receives. Is this not a stress causing a major problem??
6. CAN WE ALL AGREE THAT NUTRIENTS FROM ANTHROPOGENIC SOURCES ARE CAUSING THE DEMISE IN CORAL AND SEA GRASS COVER IN FL. AND CARIBBEAN ISLANDS? WILL THIS NOT LOWER THE METABOLIC ACTIVITY OF THE CORALS THUS MAKING THEM MORE SUSCEPTIBLE TO DISEASES?

Excess nutrients can cause the proliferation of macro-algal blooms, and cyanobacteria in and around these oligotrophic systems. Example: Sipadan Island, Indo-Pacific. In 1988 Sipadan Island had 15 rooms (huts on stilts,) on this 600 yard circle coral cay. In 1990 there were 2 more dive operators on this cay adding 30 more rooms. In 1992 another 2 dive operators added 30 more rooms, and as of 1998 I heard there were 7 dive operators on this tiny coral cay. So this small island now has 200 to 300 humans whose waste is deposited in the porous limestone substrate each day. We have photo graphed the decline in corals due to excess sediment, and proliferation of macrophytes growing all over the Acroporids and soft coral species. Gardens of hard and soft corals that once thrived on this 400meter wall in front of the island, are now 80% gone. The corals 1/2 km. out from shore are smothered with bluegreens and weedy types. The nutrient thresholds noted by Bell PRF (1992) Water Research 26:553-560, for inorganic nitrogen and soluble reactive phosphorus must be at level. This is a protected reserve, with no HCN or dynamite fishing. Therefore herbivores should be controlling the macrophytes. AND THIS IS NOT SO!

7. There are plenty of sea urchins and parrotfish, and yet still we see the smothering of algae on corals?? Why is this so??
8. LAST QUESTION: LETS SAY WE SEE AN INCREASE HUMAN GROWTH AND IN DIADEMA ANTILLARUM IN THE NEXT 10 YEARS. WILL THE URCHINS START TAKING CARE OF THE MACROPHYTES THAT ARE SMOTHERING THE CORALS? AND WHAT ABOUT THE GREEN PEA SOUP ON THE SURFACE WATERS COMING FROM PLANKTON BLOOMS? I GUESS THE WATER BELOW WILL BE CLEAR, HOWEVER, WE STILL HAVE A PHOTOSYNTHESIS PROBLEM. WILL THIS NOT SLOW THE GROWTH RATE IN CORALS?

I GUESS WITH THE GROWING CHLOROPHYLL CONCENTRATIONS WE MIGHT HAVE ANOTHER PROBLEM, INCREASE TEMPS. AND BLEACHING, I DON'T THINK THESE LITTLE CRITTERS CAN SOLVE THIS PROBLEM!

THANKS, JAMES AND STUDENTS FROM AP SCIENCE AT ST. FRANCIS IN NY.

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James M. Cervino Marine Biologist Global Coral Reef Alliance 124-19 9th ave. College Point New York, N.Y. 11356 Phone/Fax-(718) 539-8155

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...reply follows...

From Ouida.Meier@wku.edu Thu Jul 23 12:19:10 1998  
Date: Thu, 02 Jul 98 14:01:33 CDT  
From: Ouida Meier [Ouida.Meier@wku.edu]  
To: coral-list@coral.aoml.noaa.gov  
Subject: Re: Reefs at Risk

After being out of town, then reading the debate about the source and degree of threat to reefs in Florida in one lump, I forwarded the discussion to a student currently away at a field station and sent the following note along with it.

Dear Paulette,

...

The neat thing about the coral-list discussion I sent you is that the people who wrote in are some of the major players in the region. Reading between the lines, you also begin to get an idea of how nasty some of the interactions can be among scientists there - people in this field, for some reason, tend to take a position and then make it a very personal thing, maybe because one survival strategy is to become increasingly competitive/aggressive/defensive as "territories" become smaller. One would think this problem is big enough to engender cooperation instead.

You know my own take on the whole situation in Florida: most of the rigorous studies that have taken place over reasonable time periods have shown declines in Florida's reefs (Dustan and Halas 1987, Porter and Meier 1992). Our current large-scale monitoring project is also showing declines; since we're still collecting and analyzing data from that study I will mention only those facets that have been completed and publicly released so far.

The scary thing is that the data from these 3 studies show several different kinds of reef decline over time: percent cover of reef-building corals is decreasing, percent cover of fire corals (milleporids) and macroalgae is increasing, local species diversity is declining (rare corals becoming more rare), spatial complexity of the habitat is declining as branching corals die out, and incidences of disease are becoming more frequent, more widespread geographically, and more diseases are being found in more species of coral.

While in some parts of the world declines in reefs can be clearly attributed to one particular source of impact (e.g., severe overfishing, or sedimentation from coastal development), this is not the case in the

Florida Keys. Instead, I would argue that Floridian reefs should be considered severely threatened because they are exposed to multiple environmental impacts. You know from the pollution and toxicology work you're doing now that synergistic effects on organisms from multiple pollutants are frequently greater than the summed effects from each of the individual pollutants. I think the same principal of complexity of interaction applies to communities, ecosystems, and probably to the global system as well.

I think the best clue we have that multiple sources of environmental impact are at work IS the fact that we have measured multiple kinds of reef decline, without even looking very far beyond the coral components. People get frustrated when they can't trace a specific, measurably changing parameter back up its causal chain to a single measurable cause, but we're dealing with genuine ecosystem networks of interaction here, not threads or chains, with system properties like contribution of indirect effects on top of that, and with multiple sources of environmental impact on top of THAT.

This is not to say that identifying the most damaging sources of impact is an intractable problem, but effects propagate differently through network systems than they do along threads. Acknowledging and dealing with complexity is really very different from the linear ways we normally try to understand things and solve problems in science. But at this point in time, making progress with problems in complex systems like coral reefs will require biting that bullet - finding ways to deal with complexity of interaction in a rigorous fashion.

Ouida

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Dr. Ouida W. Meier  
Department of Biology  
Western Kentucky University  
Bowling Green, KY 42101  
[ouida.meier@wku.edu](mailto:ouida.meier@wku.edu)

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...reply follows...

From c.wilkinson@aims.gov.au Thu Jul 23 12:28:40 1998  
Date: Mon, 06 Jul 1998 15:05:22 +1000  
From: Clive Wilkinson [c.wilkinson@aims.gov.au]  
To: coral-list@coral.aoml.noaa.gov  
Subject: Reefs at Risk.

There has been considerable healthy discussion of the Reefs at Risk report, along with a few unfortunate, irrational comments. It is obvious that many reefs are under immediate threat of severe degradation. What is clear, is that no single approach will reverse this trend, while human populations grow and put increasing exploitative and development pressures on reefs. It requires a wide range of initiatives e.g. involving communities and governments in monitoring, more reef research, catchment management, population control etc.

Neither of the 2 parallel strategies (multiple reductionist, or few holistic reef assessments), are wrong, just different ways to obtain information and understanding. Reefs at Risk is a holistic approach, which must contain errors, but provides testable predictions. We should work to improve these, not criticise attempts to provide simpler messages for decision makers and the public, thereby smearing over some of the inherent complexity of coral reefs..

We, as a group concerned about coral reefs, are all advocates for reef conservation (whether we admit it or not). Therefore, may I request that we collectively support all efforts to conserve reefs and offer constructive criticism on those that do not conform to our ideas.

Much criticism of Reefs at Risk is of the type - 'OK, but the assessment of reef xyz is way off the mark'. Any broad assessment will suffer from this - that is the nature of the process of attempting to fill in gaps between our meagre data and information to provide a generic view. We are clearly unable to report accurately on the status of the world's coral reefs based on existing monitoring or status data. This was the consensus of the meeting organised by Bob Ginsburg in Miami, 1993.

I know, I attempted a broad assessment at the 7th ICRS in Guam in 1992 and took a lot of flak. These figures (10% lost, 30% at high risk; 30% at longer term risk) have entered into the folk law on coral reefs and quoted widely. I participated in the Reefs at Risk process to upgrade these estimates through more rigorous analysis. Thus, the new estimates based on assessing many risk factors are far more reliable than those of 1992, and should supersede them. We can use these assessments in the same way that tropical or mangrove forest people use data on tree loss generated from satellite imagery to alert decision makers to the extent of the problem. It may be a 'chicken little' approach, but it has increased attention for coral reefs - note the International Coral Reef Initiative and the recent executive order by President Clinton.

There is often a mistaken attempt to ascribe a single or small number of stress factors to explain the decline in a coral reef. Rarely do risk factors occur in isolation (exceptions are over- fishing and destructive practices on remote reefs, or global climate change). Thus we must consider reducing as many of the known factors affecting a coral reef as possible. Here, it may be instructive to examine a health model. There is usually a combination of the 7 known risk factors behind a heart attack.

Irrational dissension will not assist us in the competition for the research and conservation dollar; cooperation and collaboration will maximise our efforts.

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Clive Wilkinson, Coordinator  
Global Coral Reef Monitoring Network  
c/o Australian Institute of Marine Science  
Tel: +61 7 4772 4314; Fax: +61 7 4772 2808 or 4772 5852

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...reply follows...

From reefcare@cura.net Thu Jul 23 12:30:17 1998  
Date: Thu, 09 Jul 1998 18:43:40 -0400  
From: Paul Hoetjes [reefcare@cura.net]  
To: Coral List [coral-list@coral.aoml.noaa.gov]  
Subject: Reefs at Risk

Dear all,

During the recent discussion of the state of the reefs, several references were made to the die off of *Acropora cervicornis* and *A. palmata* due to white-band disease. In the whole discussion however, no mention was made of *Montastrea annularis/faveolata*. Yet here on the island of Curacao in the Southern Caribbean (supposedly not getting any polluted water from the rest of the Caribbean as may be the case in the Florida region) we are seeing a frightening amount of dead/partly dead *Montastreas*.

During a quarterly reef monitoring program employing triplicate point intersect line transects, that we (Reef Care Curacao, a volunteer ngo) have been doing since May 1997, we have found that between 30 and 40 % and in some cases close to 50 % of *Montastrea* colonies show recently dead patches (more than 10 % of colony area). Some of this may be due to the 1995 bleaching which was very serious here. However we also found close to 20 % of colonies diseased (in addition to the partly dead colonies), mostly with yellow-band/blotch disease, but also rapid wasting syndrome. Whatever the cause, reefs that were healthy and unmarked in 1993, look like a disaster area now.

This is the case not only in areas where human impact might be the/a cause but also in an area far removed upstream and upwind from any coastal development or pollution sources.

Is *Montastrea* showing signs of die off elsewhere in the Caribbean or are we unique in this respect? If so, is our island perhaps in the vanguard of a new wave of destruction about to sweep through the Caribbean? It may sound dramatic, but who suspected that most *Acroporas* in the Caribbean would disappear when White-band disease first started. By the way, has any epidemiological analysis ever been made of how white-band spread and whether that might indicate its origins or vector(s)?

Regards,

Paul C. Hoetjes  
Scientific Coordinator, Reef Care Curacao

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...reply follows...

From Ouida.Meier@wku.edu Thu Jul 23 12:30:22 1998  
Date: Fri, 10 Jul 98 12:06:00 CDT  
From: Ouida Meier [Ouida.Meier@wku.edu]  
To: coral-list@coral.aoml.noaa.gov  
Subject: Re: Reefs at Risk

I appreciated Clive Wilkinson's post of 6 June and wanted to respond. He stated, among other things:

"Neither of the 2 parallel strategies (multiple reductionist, or few holistic reef assessments), are wrong, just different ways to obtain information and understanding. Reefs at Risk is a holistic approach, which must contain errors, but provides testable predictions. We should work to improve these, not criticise attempts to provide simpler messages for decision makers and the public, thereby smearing over some of the inherent complexity of coral reefs."

My earlier remark about network complexity and rigorous thinking (with regard to the Florida discussion) was not intended to imply that we can't leap unless we know the names of all the streets we are flying over - frequently we don't have that luxury or even the necessary tools to trace all the complexities underlying a "big picture." On the other hand, the holistic leaps we take needn't be fatally flawed because of "mushy thinking", of which holistic approaches are often (and often unfairly) accused. For example, as Clive Wilkinson points out, one mark of a scientifically useful holistic leap is that it leaves behind testable predictions - potential road maps for how two points are connected.

His posting stimulated me to take a closer look at the Reefs at Risk report (<http://www.wri.org/indicators/reefrisk.htm>), and it seems to me that the report is in fact appropriately synthetic without being the product of mushy thinking. The authors are clear ("Technical Notes") about their data sources, decisions they made to reconcile scales, and criteria used for risk categories for each data set, and they should be congratulated for careful and conscientious completion of a very ambitious task. They also make it clear that their report is a large-scale effort to produce indicators of threats to reefs, not a summary of reef condition. As a first approximation of threats to reefs, and given the kinds of data sets appropriate to the scale they were building up to (e.g., more detailed terrestrial than marine information sometimes available), they've done a superb job, and met their stated goals and claims.

Given this information, the next step is to test predictions against observations. Areas where actual reef conditions are better than or worse than the predicted threats can be examined closely to find second order factors, or practices that overwhelm the level of threat predicted either positively or negatively. I think perhaps the Florida/Caribbean discussion could be considered in that light, not as an attempt to criticize a well-done and very useful piece of work.

Since the whole idea of reductionism vs. holism was specifically raised, I'd like to offer the following metaphor in the event that it may contribute something to our efforts to understand, appreciate, and make use of work that others do at scales of resolution that may be outside of one's usual "workspace." The structure of the metaphor implies ways of making room for cooperation, multiple perspectives, and multiple approaches in the work we do - which we need and people seem inclined to continue to develop. [If this is becoming too off-topic for you, please accept my apology and delete now.]

A couple of months ago I came to a realization of one way to resolve apparent dichotomies of reductionism and holism, analysis and synthesis, differentiation and integration. I've begun seeing these as positions along a continuum - points or regions along ongoing cycles of exploration, discovery, analysis, synthesis, and integration. My best simple picture at the moment is that we acquire knowledge and understanding in our discipline, both as individuals and as a group developing a body of knowledge over time, in repeated cycles. I made an image about it at the time, posted at: [http://bioweb.wku.edu/faculty/omeier/ana\\_syn.htm](http://bioweb.wku.edu/faculty/omeier/ana_syn.htm).

The metaphor is basically that of a circulatory system, with paths of flow going from a major vessel, splitting up into branches, then into smaller and smaller vessels, making a finely divided capillary bed, then moving by anastomosis into larger and larger vessels again. The whole thing resembles a directional network with variation in path width, length, and connection. (There are obvious

shortcomings in the drawing, e.g. represents only the surface of the structure. Different advantages to "vessel" and "path" language . . . )

There are some processes and situations that are embraced usefully by this metaphor. For example, people who think of themselves as reductionists work more to develop the finely divided "capillary" regions of detail, precision, and specificity of process and theory. People who think of themselves as "holists" may spend more time constructing and connecting broader, more aggregated pathways. Our discipline (any discipline) as a whole accumulates knowledge over time by incorporating discoveries at all levels of resolution, or at all regions of the cycle, repeatedly. As a collective, we build the body of knowledge - the directional network of information that is the circulating structure - as we go; we hope and believe by our testing that the paths we discover or lay down are firmly supported by reality.

If we are lucky, in our individual careers we knowingly move through complete cycles of analysis and synthesis. We try to avoid "stagnating" - experiencing no flow, and "getting into a rut" - traveling one narrow pathway over and over again until it becomes unnecessarily entrenched and rigid. (Without habitually recognizing, examining and integrating "new stuff", we lose our joy and openness to new connections in our work.) Through time some areas of a discipline become highly vascularized with more work and more able work, while other regions experience decreasing flow as interest, funding or relevance wanes. Sometimes we work to build depth, connection, and precise detail along partially known pathways (reductionism), and sometimes our efforts are focused on syntheses, broad connections, and generalizations (holism), but clearly these efforts don't just coexist, they feed and depend upon each other.

I wouldn't want to push this metaphor much farther, though there is the heart (driving forces and motivation), and organs (the larger structures we serve - I'm convinced the world tolerates scientists only because once in a while we are more useful than not). Anyway, for what it's worth . . .

Ouida

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Go back to the [Top of the Document](#).

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Return to the [Coral Health and Monitoring Program Homepage](#).

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**This page was created by James Hendee. It is maintained by Monika Gurnée.**